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Putting technology in place successfully

CLAUDIO M. LEVATO, D.D.S.

Schleyer¹ states in this supplement (pages 4S-9S) that only about 25 percent of all general dentists in the United States use computers at chairside. This is a critical prerequisite to having an integrated technology solution for a dental practice. I have written this article to help dentists understand how all of the technology in the office fits together and to provide viable solutions to meeting the needs of the emerging digital practice.

FACILITY AND TECHNOLOGY PLANNING

The first and most important task in this process is the planning phase. We have to look at our practices and ourselves objectively and look at the resources we have available. Is the quality and productivity of our practice meeting our current expectations? If not, are we capable of integrating technologies on our own or do we need to hire a consultant? We have a clear vision, which includes the specific technology functions we

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desire, as well as the realization that there are objective costs such as hardware and software and the subjective costs of time and effort that need to be addressed.

Integrating technologies is not merely adding clinical applications such as intraoral cameras and digital radiographs to a computer system. It means merging all aspects of practice management, business applications, and clinical information and applications into a seamless and intuitive data management and communication resource.

There are several design choices dentists usually use when they want to build a new facility or remodel their existing one.²

Unthank³ addressed those issues in his article in this supplement (pages 24S-29S), and Spallek⁴ has compiled an extensive resource guide (pages 38S-44S), which provides additional information.

When I consider making significant changes, I

Background. This article discusses how to integrate clinical and administrative workstations into your dental practice from the planning phase to the implementation phase.

The author discusses the costs that are associated with integrating technology, as well as the hardware components and configuration. He then discusses in greater detail the core clinical technologies and how they tie in together to facilitate building a cohesive digital patient record.

Conclusions. There are no shortcuts to successfully integrating technology into a dental practice. A significant commitment of time, energy and money is a prerequisite to building a secure and reliable computer network that incorporates all clinical and administrative applications.

Practice Implications. Technology is reinventing the world, and dentists need to keep pace with the people they serve. These new and not-so-new technologies will enhance dental services and productivity, which ultimately will raise the bar for the standard of care in dentistry.



return to the basics. The blank-sheet approach is a great starting point. If you had no limitations of time, energy or money, what would your vision look like? This is where visualization comes in handy. You want to create as vivid and clear a picture of your goal as possible, and you want to imagine what it is going to look like, feel like and how it will function.

After you have a clear vision, you then can start putting numbers to it. You need to figure out exactly how much your vision is going to cost with all the bells and whistles you desire. This step is just as important as the first step, because when you calculate how much it is going to cost you, only then can you answer the hard question, "Am I willing to pay that price for my vision?" If you are not willing to pay the entire cost, you then have to change the vision. This may seem to be a little extreme, but I firmly

believe that too many people just go with the flow, never really analyzing what they are doing or what they want to be doing. So this concept of introducing or adding technology to our practice now can be viewed as a major opportunity to revisit our lives and refocus our energies.

Once you have created a vision that is real and at a cost that you are willing to pay, you can start with your implementation phase. You need to look at your current practice assets. Is the physical plant sufficient? What do you already have that you can use and what has to be discarded? This is where you have to decide on whether a new facility will be required or if you can retrofit the technology to fit what you have. The first step of the implementation phase is to determine your financial commitment or budget. There are six areas of monetary investment that you need to consider.

The cost to educate yourself to make informed decisions. Most people do not even consider what they are investing when they research information. Time is a nonreplenishable asset. You have only so much of it, and there are no do-overs in real life. You need to realize that making an informed decision about incorporating technologies requires some thought and action. You also need to look at the timeline of your project. You could invest years reading articles and going to trade shows, but this is not always the most productive route. There are numerous consultants who can shorten your learning curve and help you customize solutions that will make your office operational and functional sooner. For example, you can review Anderson's⁵ article on just some of the criteria that can be used to expedite your decision-making process.

The actual cost of technology: hardware and software. This probably is the easiest part of technology planning. There are several companies that dominate virtually all the technology applications, and they are present at all the major dental meetings. Competition is good because it helps bring new applications to market and increase the overall quality of applications and equipment. There has been a lot of consolidation in the technology arena for dentistry and this probably will continue. Therefore, one important consideration is to buy from a company that has the ability to survive in the industry and that has the resources to support whatever you buy.

The cost of training. Technology continues to change and, unfortunately, so do our staffs. Initial training is just the beginning. You need sys-

tems in place to train new staff members and to provide ongoing training to help existing staff members become more productive with the technology tools you have purchased. Unfortunately, most dental practices use only a small fraction of the software applications they purchased. Feuerstein⁶ explains the benefits that technology offers to our patients and our practices. It does not make any sense to not maximize those benefits, as you already have paid for them.

The cost of support. Support is critical because we are human, and we sometimes will forget how some things are supposed to work. Therefore, you need to provide resources for your staff members, so they can continue to learn the systems you have purchased.

In the ongoing struggle for continual improvement, software updates are a necessity. With updates, other issues often arise. Infrequently, there is a bug in the software that you cannot fix, and the system does not work precisely the way it is supposed to, so you need to have support. Other times, you or your staff members do something on one of the workstations that results in the computer workstation's crashing. Again, you need support. At other times, you may decide that you want to add an unrelated program to your computer, and it is somewhat incompatible. Yes, you need support then, too. And finally if your system crashes without warning and cannot be rebooted, you need support. You need to remember that dentists need to be with patients and cannot be held hostage to their technology. Therefore, you have to allow your staff members to work with the support companies to keep everything functioning without bringing you into the fray.

The ongoing costs: obsolescence. Computer hardware has a limited effective life expectancy. Computer processors keep getting faster, and applications seem to expand on a regular basis. This is just a fact of modern life. If a system is working perfectly fine for you and is doing everything you want it to, you can keep using it for a long time. Unfortunately, if you want to add new applications or ancillary hardware, the existing workstation may not be compatible if it is a few years old. Therefore, you may need to upgrade your hardware to make that happen. Hardware is not the only thing that becomes obsolete; operating systems may change. For instance Microsoft (Redmond, Wash.) no longer will support its Windows 95 operating system, and some of the computers that came with Windows 95 (Microsoft) installed may not be

able to run Windows 2000 (Microsoft) or Windows XP (Microsoft) without significant upgrading.

The opportunity costs. There are applications available that may not work with your system. An example would be purchasing a capture card for your computer that is not compatible with your intraoral camera software. Purchasing incompatible or less effective components usually will cost you more than the money saved by buying a less-expensive application. Using the previous example, using an incompatible capture card in an intraoral camera can result in a poor-quality image, which will negate many of the benefits that a good image will deliver when communicating with patients, insurance companies or dental colleagues. The opportunity to communicate visually is dependent on the quality of that image.

There are many nonnegotiable costs of going digital. You need to be able and willing to allocate specific sums of money to make the transition. You cannot have an integrated IT solution for your dental practice if you do not have a network that connects your clinical and administrative workstations. This will cost money and so will support, training and equipment upgrades. Therefore, an ongoing technology budget is essential.

NETWORKING ENVIRONMENTS

The connectivity of computers and associated devices is referred to as a network. A local area network, or LAN, is a configuration that connects a server, workstations, printers and other devices with a common communications line or wireless link. A LAN may serve as few as two or three users or as many as several thousand. The key factor is proximity of users within a building or among buildings that are tied together by the same wired or wireless connection.

A computer network that spans a relatively large geographical area is a wide area network, or WAN, which consists of two or more LANs. Computers often are connected to a WAN through public networks, such as the telephone system, and both leased lines (cable, fiber-optic, telephone) and satellites. The largest WAN is the Internet, which is the worldwide network of interconnected computers, all of which use a common protocol to communicate with each other.

ESSENTIAL INFRASTRUCTURE COMPONENTS

Server. The first step to going digital is obtaining the hardware and establishing the interconnec-

tivity of hardware, which also involves considerable software in making all those pieces work. Computer workstations, servers, printers, scanners and other input devices need to be connected together. The heart of the system is the server, which should be a dedicated central processing unit that is not used as a workstation. A dedicated server should be your most significant piece of computer hardware, because it is the repository of your vital practice data.⁷ A level-5 redundant array of independent disks, or RAID 5,⁸ system and automatic daily backup software are essential security features. I recommend that the server have the fastest processor on the market with the largest hard drive capacity for storage. Most servers have the capacity for six hot swappable drives that can be removed while the processor still is turned on. The RAID 5 configuration requires at least three hard drives, two of them which will store the data and the third that serves as the parity drive, which rotates the data among the three drives. This system will let you automatically restore the data on a new drive if one of the three fails.⁹

Workstations. If the server is the backbone of your network, the computer workstations are the arms and legs. The workstations are where you and your staff members will be spending more and more of your time. When designing workstations, you need to be aware that this is an office component that already is on the Occupational Safety and Health Administration's radar. Ergonomic workstation design is a factor in employee health,¹⁰ and if you follow some simple guidelines, you can maximize employee productivity when working on computers. I recommend your clinical workstations be equipped with the fastest processor available when you purchase it (currently 3.4 gigahertz), as well as at least 512 megabytes of random access memory. The operating system should be Windows XP Professional (Microsoft) if your software is compatible with it. According to Microsoft, it is the most reliable MS Windows (Microsoft) operating system.¹¹

Cabling. Computers need to be connected. The current state of the art in cabling is category 6, which requires conduit. This may not be practical for remodeling, but it would be a wise move for new construction. Category 5, or 5E, can handle all your needs for today. When it comes to wiring, one problem that is mentioned rarely is the wiring mess at the back of the computer. When designing operatories, it is important to build

“raceways” in the cabinetry or in the floors to facilitate running wires while minimizing the tripping hazards and the inadvertent disconnection of some wire during the cleaning process.

Wireless networking. One would think that a wireless network¹² would be a godsend; however, there really is no totally wireless connectivity for dental networks. Wireless systems need transmitters and receivers to connect together, the receivers need to be connected to the workstations by wire, and transmitters need to have batteries, which have to be replaced. Using a wireless connection in limited circumstances with a hard-wired network could provide flexibility and improve workflow, but there are limitations that have to be considered. For instance, the Schick wireless sensor (Schick Technologies, Long Island City, N.Y.) works on the 2.4 GHz spectrum and has three channels available so that you could use three sensors at the same time without interference. But you may get outside interference if you also use a computer-aided design/computer-aided manufacturing, or CAD/CAM, system or a wireless phone that use the same 2.4 GHz spectrums. When you have the opportunity to eliminate wires, you may limit some of your other choices.

There is a truly wireless network if we look at the big picture on technologies. This is an outgrowth of the Internet and cellular telephone technologies.¹³ The Internet can be accessed by laptops, cell phones and personal digital assistants with no cords attached, allowing people to network without a physical connection to a particular computing device. This type of physical independence still is out of reach for day-to-day dental applications. Even though there are companies that provide dental practice management software as an application service provider, or ASP, these programs are just beginning to offer clinical applications such as imaging and charting. When practice management ASPs are completely competitive with their in-house computer-based rivals, wireless solutions may change completely the way we use computer technology in dentistry.

Dentistry always has been a cottage industry when it comes to computer applications. In the scientific, industrial and governmental communities, there are supercomputers that can process data at phenomenal rates that are measured in trillions of bytes per second. These systems could cost hundreds of millions of dollars to build and as many to maintain. In our real dental world,

however, it would be very difficult for a solo practitioner to budget even \$100,000 for hardware components. That means that we, as small businesses, still need to work within the personal computer world.

CORE CLINICAL TECHNOLOGIES

Once your office has a network of connected computer workstations that allow for the bilateral flow of data from your business and clinical areas, you are ready to incorporate the clinical core technologies. For this to happen successfully, you will have to invest in a practice management software program that has the capability of providing both the administrative and clinical applications, preferably in a single database solution.¹⁴ The core clinical technologies are

- charting and progress notes;
- digital radiology;
- intraoral and digital cameras;
- communication and corresponding applications.

Charting and progress notes. The chart has always been a roadmap for patients' care, and every practice management program that has a clinical application has a charting system. Most of the charting systems will allow you to chart existing, completed and recommended conditions, and many of them have the ability to attach images to the teeth in the chart. Digital charts are an improvement over paper charts.

Depending on the “depth” of your software charting program, you can open a window to view radiographs, images, notes and letters from specialists, laboratory sheets and anything else that may be attached to a particular tooth. In my opinion, the best part is that you also can do your treatment planning from the chart and have the charting automatically change to reflect completed work.

- Dentists who use only paper charts might ask
- How long will I have to train before I can use the system?
 - Will it be faster than paper charting?
 - Will the computer charts have more mistakes than paper?

These questions are valid, but treating charting as a stand-alone system is not the point. The bigger issue is integrating clinical components into a digital package, in which the overall benefit is greater than the individual parts. In reality, paper charting is faster and more accurate only because people are accustomed to it. Once they learn and use digital charting, their speed and

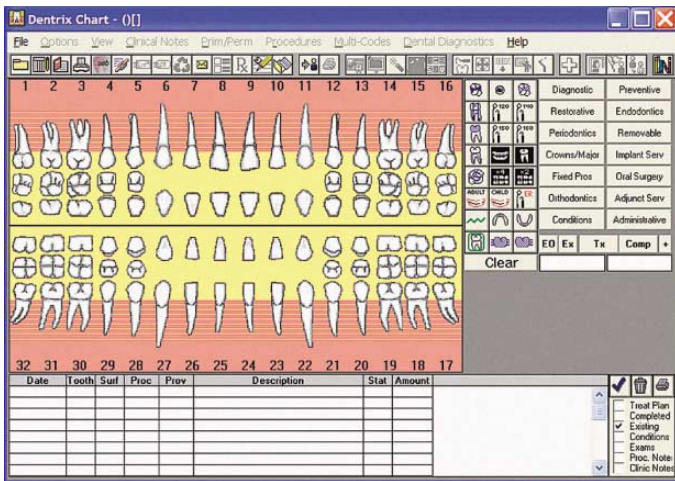


Figure 1. Example of a blank computer chart.

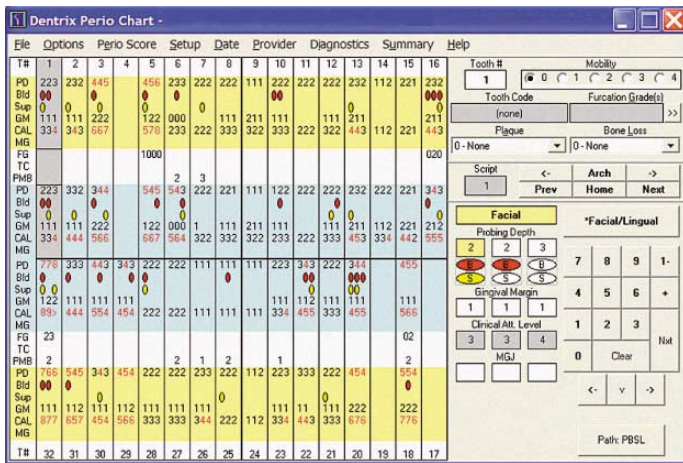


Figure 2. Chart showing periodontal charting only.

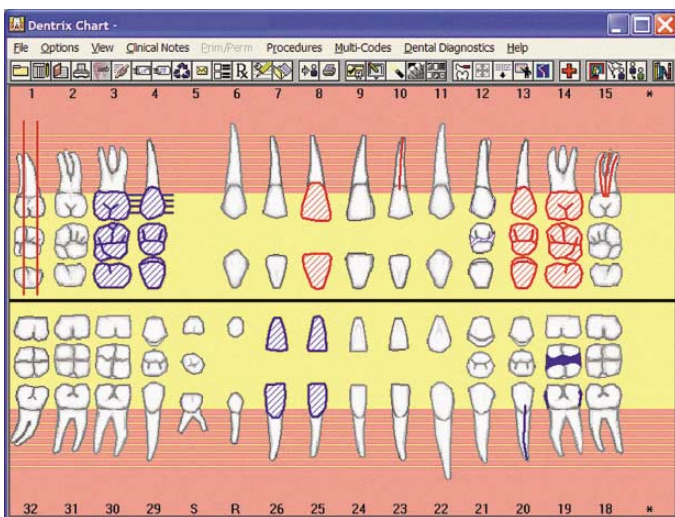


Figure 3. Chart showing current conditions and planned treatment.

accuracy most likely will increase to levels beyond those found when using paper charting in time.

The best way to implement a digital charting system is to make the time to have your staff members trained on your particular system. All software programs have an initial training session for new clients, and they all have ongoing training sessions or compact disc training programs that you can use for your staff members. It is critical that your charting system is compatible with your office. Most charting programs have user-defined parameters that can be tailored to fit your style of practice (Figures 1-5). I suggest that you think about which features or what information you want on the chart and start with a simple version. You can modify it as your needs change.

The timesaving and organizational control you get from using this form of documentation is phenomenal. It could only be better if we could use it via voice activation. Voice-recognition products can support continuous speech and large vocabularies and have the ability to distinguish between commands and text purely from content.¹⁵

In dentistry, we had voice-activated charting beginning in 1986 with the introduction of Simplesoft (ProDenTech, Batesville, Ark.), which later became Victor Charting. In 2003, Dentrix Dental Systems (American Fork, Utah) introduced a dictation application to work alongside their voice-activated charting application, which allows dentists to enter their charting and progress notes hands-free.

Digital radiology. Digital radiology is the cornerstone of the digital clinical record. Dentists use radiographs every day of their professional lives. Incorporating radiographs into a digital medium makes them infinitely more usable if for no other reason than to be able to view them on a monitor. They can be magnified to fill a 17-inch monitor, which makes it virtually impossible for you not to see what you need to. You also can enhance the image using the software tools that allow you to adjust the contrast to highlight the anatomical differences between the different tissue types and measure file length for endodontic procedures. In his lectures, Miles has stated that one good digital radiograph is comparable to three good film radiographs. He has written a 43-page booklet, which describes the basics of digital imaging, image acquisition and what he calls "electronic image processing."¹⁶

One stumbling block dentists have had with digital radiology is the proprietary nature of the marketplace. It is predicted that soon there will

be a solution that will give dentists the same interoperability that intraoral cameras provide. Digital Imaging and Communication in Medicine, or DICOM, standards are being worked on by the ADA and should be in place soon. They will provide the framework for the electronic transfer of information across hardware platforms.¹⁷ Simply put, if you use GX-S HDI USB sensor (Gendex, Des Plaines, Ill.) for digital images, the endodontist uses ImageRAY (Dentrix), and the oral surgeon uses Dixi2 sensor (Planmeca, Helsinki, Finland), you will be able to share images within your own software programs, because all of your systems will allow you to export and import images in a DICOM format. Dove,¹⁸ Farman,¹⁹ and Benn and colleagues²⁰ have published articles that further explain DICOM.

Putting digital radiology in place in your practice is not that hard provided you already have a computer network in place. The beauty of a networked system is that you can view any images from any location, which means that you can view radiographs taken in the hygiene room before you even enter it. The technique of taking digital radiographs is similar to what your staff members already are doing. With a little training, you and your staff members will be able to master this application. The benefits of converting to digital radiology have been presented in lectures and are listed the resource guide in this supplement.⁴ Another great resource is "learndigital.net".

Intraoral and digital cameras. Just like digital radiographs, intraoral images have become an integral part of dentistry's clinical armamentarium, and they are much easier to incorporate into your practice because the standards for capturing video images are not proprietary. You can choose virtually any intraoral video camera and make it work within your software.

The first intraoral cameras in dentistry were modified endoscopes, and they cost more than \$35,000. Today, the price range is from \$3,000 to \$8,000, depending on the features and optics. Not all of today's cameras require an S-video or composite connection. The AcuCam Concept IV (Gendex) intraoral camera has a high performance serial bus connection, which has a sharper image than the conventional S-video connection. ImageCAM USB 2.0 digital (Dentrix) offers a sharp image and eliminates the need for a capture card. Schick's intraoral camera is a universal serial bus, or USB, camera that uses a light-emitting diode light source. Regardless of which

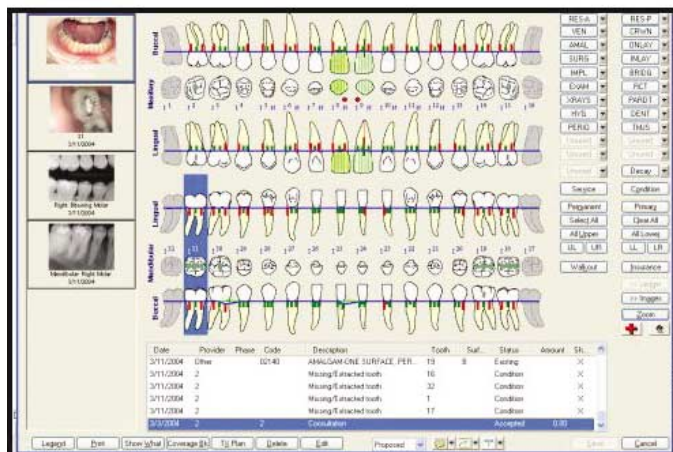


Figure 4. Chart showing periodontal charting, existing conditions and attached images of tooth no. 31.



Figure 5. Separate windows of attached images of tooth no. 31 on top of the open chart.

intraoral camera you select, the image can be captured directly into the patient's digital record. A common complaint is about the number of steps required to make that happen. Which software you are using and what screen you are on will determine how many steps it takes you to capture an image.

In my practice, I use an intraoral camera with every patient and procedure (Figures 6 and 7). I do this to document the procedure, as well as to allow myself to view what I am doing in much greater magnification. I can see things with the camera that I miss with my loupe. When designing my treatment rooms, we placed a keyboard and mouse on both the dentist's and assistant's side of the chair. With this configuration, I can keep the image screen on the monitor easily.

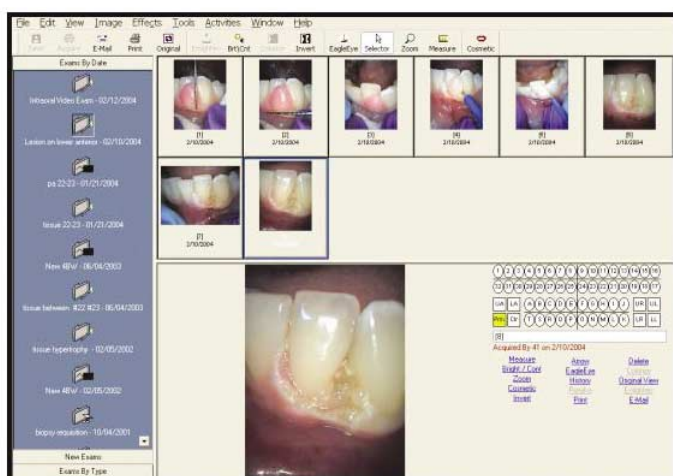


Figure 6. All of the images taken at one visit open on the screen.



Figure 7. Two images open in separate windows for comparison.

And when I pick up the camera, the image is live, and I can use a foot pedal to freeze and save the image. In this scenario, I have immediate access at all times. If my assistant has to change screens, she will return the camera screen to me when she is done.

Communication and corresponding applications. Now that dentists have the ability to capture instant digital images chairside, they have the capability to share the images with anyone else in the world. If you have a broadband Internet connection in your office and you have your network configured to be accessible throughout your office, you can be connected to the millions of people on the World Wide Web. More specifically, companies like Transcend (Boston) have several products that provide

secure Internet communication between dentists, dentists and laboratories and dental schools and laboratories. Transnet (Transcend) allows for communication via any portal to the Internet, and it is not limited to specific platforms or proprietary practice management software programs. These applications can connect everyone in real time.²¹ Dental software companies such as Dentrax offer similar applications to their users.

Many dentists spend hours online after work in direct pursuit of dental communication in Internet forums such as genR8TNext (“genr8tnext.com”), DentalTown (“www.dentaltown.com/”) and Internet Dental Forum (“www.internetdentalforum.org/”). There they can exchange ideas, frustrations and techniques or just take it all in. Computers and the Internet have made the world so much smaller and dentists’ contacts so expansive that they are a part of a “global village.” In the past, dentists worked in solitary environment, to say the least, but technologies, techniques, materials and staffing did not change as rapidly as they do today. The Internet allows dentists to seek help on just about anything they would need in the practice of dentistry and in the search for camaraderie.

There is and will continue to be an ever-expanding list of new technologies that will perform specific applications that will not be integrated into your network. Instruments like lasers and air-abrasion, CAD/CAM and implant systems that have meaningful and powerful applications are beyond the scope of this article, but you definitely need to consider them when planning, designing and budgeting for technology.

CONCLUSIONS

I do not know of any shortcuts that will allow dentists to integrate technology successfully without emotional and financial commitments to a network that incorporates clinical and administrative workstations to a secure server and provides access to the Internet. Without this backbone, the seamless exchange of digital information within and outside of the dental office is compromised, which in my opinion, means the technology integration is not successful.

There are some significant costs to undertaking this quest, but dentists of the future most likely will be as dependent on this technology infrastructure as dentists today are dependent on their air-compressors and vacuum systems. Dentists

need to reinvent their practices so they can provide the services the marketplace requires more effectively. This may mean that dentists will merge practices to defray some of the hard costs of technology. Others may educate their patients about the benefits these technologies offer so that they will be more willing to pay the appropriate costs.

Regardless of the type of practices dentists have, it is their responsibility to make sure they invest in themselves and their practices and that they receive a financial return on their technology investment. ■

Dr. Levato is in full-time private practice, Comprehensive Dentistry, Bloomingdale, Ill., and is technology editor, Dental Practice Report, Northfield, Ill. Address reprint requests to Dr. Levato at 183 S. Bloomingdale Road, Suite 200, Bloomingdale, Ill. 60108, e-mail "cleavato@comprehensivedentistry.com".

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