A Model for Assessing Digital Image Use and Needs

Report of a Study into Digital Image Use in North American Dental Education

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This study is presented as one possible model for assessing image use and needs that can inform planning for and creation of a digital image repository. The study described here specifically sought to provide basic knowledge about the current use of digital images in North American dental schools, as well as what future needs might occur among digital image users. It was conducted as part of an ongoing needs assessment for possible construction of an online repository of digitized dental images. The research team conducted semistructured interviews with a purposive sample of dental faculty members at a representative dental school, as well as a brief survey of academic deans. Findings indicated use of digital dental images is nearly ubiquitous among faculty members, but that not all of their needs are being met. The faculty members would benefit from access to an online repository of high-quality digital dental images with accompanying metadata.

Many institutions and disciplines are exploring the creation of digital image repositories. The research project described here investigates questions pertinent to most types of digital image repositories—namely, the needs that drive image use, whether these needs can be met through an online repository, the functional elements that image users would be most helpful, and whether individuals would be willing to contribute images to a shared repository. The process followed in conducting the research reported in this paper can be applied to research into other types of discipline-based image repositories.

The needs assessment described in this paper was prompted by the presence at the University at Buffalo's (UB) School of Dental Medicine of a collection of high-quality dental slides donated by a retired faculty member to be made available to the educational community. The extensive collection includes slides that could be professionally digitized and made available online as the core of a repository of digital dental images. The collection is currently in physical form.

Rather than simply making the images available within the school, the research team decided to assess the feasibility of making the images available to the broader community of dental faculty members and researchers. This needs assessment was designed to determine the image-related needs of dental faculty members and to

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determine whether an online repository of digitized dental images could meet any needs discovered during the study.

To provide basic knowledge about dental-image use by faculty members at North American dental schools, and how efforts to provide an online repository of digitized dental images might help the work of those faculty members, this study asked the following research questions:

RQ1: What needs drive digital image use by dental faculty members?
RQ2: Can the respondents' needs be met by the creation of an online repository of digitized dental images?
RQ3: What functional elements of the proposed online repository of digitized dental images would be most helpful to users?
RQ4: Would members of the larger dental community be willing to contribute further material to the proposed online repository of digitized dental images?

The research team conducted the needs assessment in three stages. In the first stage, members of the research team conducted semistructured interviews with dental faculty members at the UB School of Dental Medicine. The second stage involved a brief national survey of academic deans from North American dental schools. The third stage involved a longer national survey of dental faculty members from North American dental schools.

Background

While several articles have addressed the use, or potential use, of images in dental practice, little is documented about the content and types of images needed or how they are collected, stored, and retrieved by dental professionals, faculty, researchers, and students.[1] This basic knowledge is necessary for establishing the context into which a repository of digitized dental images might be introduced.

As use of computing and imaging technology continues to move forward, dental schools continue to train faculty and students to use computing technology. According to a 2002 literature review performed by Hendricson of the San Antonio Health Sciences Center, 558 English-language articles from 1996 through 2002 were published addressing some aspect of computer-assisted instruction in the health professions.[2] A companion piece published by Hendricson and colleagues found that 86 percent of North American dental schools have already expanded their use of information technology as part of their curricula, with 82 percent hoping to increase IT use further.[3]

Many dental faculty and practicing dentists throughout North America have amassed large collections of images over their years in the field. These images exist in many forms: digital, plastic and glass slides, and video tape, for example. While most faculty use their own collections daily, many do not have an easy way to share their collections with others, or to make use of the collections of others. Dental practitioners are also using computers extensively in their offices. According to Schleyer and his colleagues, only 1 percent of dentists used computers in their offices in 1976, but this had changed by 2000, when "85.1% of all dentists in the United States used a computer in the office."[4] While discussing the patient-dentist experience in a technologically equipped office, Feuerstein pointed to digital photography and radiology as tools to enhance the visual clinical examination and patient consultation.[5] In an article exploring the role of IT in the dentist-patient relationship, Kirshner noted that "digital imaging may have the most profound effect on the dentist-patient relationship, due to its immediacy and ease of understanding through recognizable visualizations."[6]

Casual sharing of images is unlikely to have the effect that an organized repository could have. Fortunately, the infrastructure already exists for the delivery of high-quality medical images and appropriate metadata in the form of the Health Education Assets Library (HEAL, www.healcentral.org). The research team has been in contact with staff members at HEAL, and the inclusion in HEAL of the images from the UB School of Dental Medicine donated collection is feasible, pending funding. Part of the planning process includes producing standards-compliant metadata that can be cross-referenced with HEAL metadata. This paper, however, focuses on establishing basic needs on the part of dental faculty members and researchers.

Research Method

The semistructured interviews in the first stage were meant to elicit detailed information about the use of images in the working lives of dental faculty members. The sample for this part of the study was a purposive sample for heterogeneity. The interview respondents worked in a variety of dental specialties, including several respondents who worked in allied health specialties and taught within the School of Dental of Medicine. The questions that were used to guide the interviews are presented in appendix A.

Semistructured interviews were appropriate for the first stage of the needs assessment because they allow an interviewer to cover a list of important topics, but also allow for exploration of unanticipated themes during the interviews.[7] Thus the interviewers could cover planned questions such as whether interview respondents preferred digital or nondigital images, as well as unanticipated questions about reasons the interview respondents had for using particular types of images. This was an appropriate approach for a

study designed in part to establish baseline knowledge in an area where there is considerable anecdotal knowledge but a relative paucity of empirical studies. A total of 16 semi-structured interviews were conducted as part of the study. The respondents were numbered R01–R16 to protect their confidentiality.

Members of the research team used content analysis to sort the interview respondents' statements on the basis of whether the statements referred to one of three types of image use:

1. General image use; that is, the form of the image (digital or nondigital) was not specified
2. Use of digital images
3. Use of nondigital images

Within each category, the coders further grouped the statements on the basis of whether each statement referred to a prompt (a positive factor that motivated use of a particular type of image—for example, the ability to manipulate digitized images), or a hindrance (a negative factor that provided motivation to not use a particular image type—for example, the need to develop film for physical slides). A Description category was used for statements that named an image type without elaboration. But the Prompt and Hindrance categories will remain the focus here.

Because multiple members of the research team participated in the content analytic coding of the interview statements, chance agreement represented a threat to the validity of the results of that analysis. For example, in deciding whether each statement should be grouped under Prompt or Hindrance within each image type, random chance could lead to a deceptively high level of agreement. To counter this possibility, the results of the content analysis were checked using Cohen's Kappa, a statistical measure of inter-rater reliability and a commonly used check against chance agreement.[8] An accepted set of criteria for interpreting Cohen's Kappa sets greater than .67 as the threshold for allowing preliminary conclusions, and greater than .80 as the threshold for indicating good reliability.[9] In all cases, the scores for Cohen's Kappa exceeded the .80 threshold, establishing good reliability for both content-analysis schemes (sorting the statements by the resource type to which each statement referred, and by Prompt, Hindrance, or Description).

The survey of academic deans performed for the second stage of the needs assessment was meant to provide context and validation for the semistructured interviews. Along with the risks to validity mentioned above, there was additional risk inherent in drawing all of the interview respondents from a single dental faculty. To reduce this risk, the team members decided to conduct a brief e-mail survey (see appendix B) of academic deans at North American dental schools to provide at least a preliminary determination about whether the experiences described by the respondents at the UB School of Dental Medicine validly reflected the experience of dental faculty members elsewhere. Respondents for the e-mail survey of academic deans in the current study were recruited through an electronic discussion group that reached the academic deans of North American dental schools. In the survey, 18 of 56 academic deans responded, for a response rate of 32 percent.

The longer survey (appendix C) for the third stage of the needs analysis was meant to provide additional validation for the basic needs found in the first two stages and to begin determining the suitability of potential metadata elements for use in the proposed online repository of digitized dental images. The third-stage survey also sought to begin determining whether members of the larger dental community would be willing to contribute material to the proposed repository.

Two rounds of e-mail invitations were sent to potential respondents. The first round of invitations went out to 536 potential respondents from the American Dental Education Association's list of department chairs. A total of 78 messages failed for various reasons, for a total of 458 successful messages. In the second round, a slightly smaller number of messages (528) were sent. The smaller number resulted from the removal of known incorrect addresses. A total of 43 messages failed for various reasons, for a total of 485 successful messages.

Sixty-seven individuals responded to the survey. Basing the response rate conservatively on the larger group of messages (485) yields a response rate of 14 percent. This is somewhat lower than average, but not completely out of line with a reported response rate to Web surveys of just under 21 percent when all invitations are sent by e-mail.[10]

Results

RQ1: What Needs Drive Digital image Use by Dental Faculty Members?

Virtually all of the interview respondents (15 of 16) used dental images in their work. The one respondent who did not use dental images made use of nondental images. The interview respondents showed a strong overall preference for digital images. Table 1 shows a breakdown by resource type of how many statements the respondents made that referred to Prompts or Hindrances in their use of each resource. For example, the respondents made 92 statements that referred to prompts for image use and 31 statements that referred to hindrances to image use, for a ratio of 2.97 statements that referred to a prompt to each statement that referred to a hindrance. Statements that contained simple descrip-

tions of resources used (coded under Description) were not included here because, by definition, those statements did not tell anything about the prompts or hindrances encountered by the respondents in their use of each resource type. The descriptive statements were used to establish context during the course of the study, and constituted less than 11 percent of the total statements.

Table 1. Frequency and ratio of prompts and hindrances for image use

Resource	Prompt	Hindrance	P:H
Image	92	31	2.97
Digital Image	186	83	2.24
Nondigital Image	9	10	0.90
Total	614	319	1.92

The relatively high number of statements referring to digital images, along with the strong preponderance of prompts to hindrances in using those images, demonstrate the relatively high regard the respondents had for digital images compared to nondigital images. Nondigital images constituted the only resource type with a negative ratio of statements about prompts to statements about hindrances. References to image use that did not specify the type of image (digital or nondigital) also contained a strong preponderance of references to prompts over hindrances, reinforcing the idea that general image use is very common among dental faculty members.

The images met a number of needs on the part of the faculty members. Classroom use of images accounted for a very significant portion of the prompts mentioned. Other prompts included the comparison of healthy and diseased tissue, and the illustration of how a condition might develop. R02 indicated that image use can allow an instructor to show "the etiology, the root cause of the problem." Other prompts for image use included "patient education" and use in journal articles and book chapters (R15). Image quality was also a concern for the respondents. They were concerned with factors such as "true representation of colors and contrast" because, for example, "you want it to be an accurate representation of what the students may encounter in the clinic in the live state" (R01).

The hindrances described by the respondents substantially mirrored the prompts. For example, the respondents expressed concern with the availability of a full range of images. R05 indicated that "If we're trying to illustrate a type of cancer or something, and we want to see the microscopy of it or the histology of it, it may not readily be available."

The patterns of prompts and hindrances in the use of digital images followed a similar pattern. But there were differences. Some of the respondents pointed to purely practical problems. R02 mentioned that digital images were "much [more] convenient, because then you don't worry about carrying slides." The ability to edit digital slides also played a role in the respondents' use of digital images. R03 pointed out that "you can revise them," and "you can add text." Such operations would be more difficult, or impractical, with nondigital slides. Variety also played a role with digital image use. R07 indicated that "If you look at any one atlas there may be one or two pictures of a certain condition, so it may be helpful to be able to look at more pictures of a condition to then to try to match it to something that you're looking at."

The hindrances with digital images also mirrored the prompts. A comment by R06 summed up one of the problems well:

> We need more [images]. Because a lot [of] times what I'll get, is for example, if I want to show them a gum disease, I'll go the textbook on the DVD and a lot of them, the images are not in color in the textbooks. You'll find some textbooks have all color plates and you can use those but usually you can only get one example of the disease so you can't show students the range of what the disease could look like. So if we had more appropriate images it would be better because we could show students the range of what how diseases look.

General image quality was also an issue. R02 indicated that, "With the imaging, I think some of it is, we lose this kind of quality in terms of the depth of the picture." Currency could also affect the perceived quality of the picture, with R01 pointing out that, "If I showed a picture and they have a 1950s hairdo, I'd get an eye roll from the students." The respondents also expressed various technology-related concerns about factors such as the reliability of the technology, and occasional difficulty with image manipulation. For example, R01 indicated that image quality sometimes suffered when the image was projected for a group of students: "The only shortcoming when I move it [a digital image] to PowerPoint is that it may look good on my screen, but it doesn't always project the same way."

As mentioned earlier, nondigital images constituted the only resource category in which the respondents made more statements that mentioned hindrances than statements that mentioned prompts. The respondents also made fewer statements grouped into this category, by far, than the other categories. Only 19 total statements addressed prompts and hindrances to the use of nondigital images. In contrast, the interview respondents made 123 statements referring to prompts and hindrances to general image use, and 269

statements referring to prompts and hindrances to digital image use (see table 1).

Image quality was one prompt to the use of nondigital images mentioned during the interviews. R09 possessed an intra-oral camera that yielded images that were superior in quality to images taken with a digital camera: "With the intra-oral camera, it's designed for close shots, and I think . . . the lens is far superior." Purely practical considerations also played a role. R01 indicated that nondigital slides acted as a substitute: "Only when I'm caught really short, or I need to [find] something quickly, would I show the [non-digital] slides."

Lack of physical slide projectors presented one of the main hindrances to the use of nondigital images. R02, for example, retained nondigital slides but did not use them: "Now it is inconvenient to use it [nondigital slides], because there is no more machines, but I have physical [slides]." The traditional film cameras, despite better image quality when compared to digital cameras, also brought inconveniences. R09 pointed to the inconvenience of having to develop film: "But then it's [the nondigital camera] always a ways away between getting the film developed, and then getting it on to the computer." The difficulty of altering or editing nondigital slides was also mentioned.

In general, the number of statements regarding digital and nondigital images and the proportions of Prompts and Hindrances described by respondents in those statements, indicated a strong preference of the faculty members for digital over nondigital images. The preference was so strong that at least one respondent was willing to sacrifice a reasonable amount of desired quality to gain other conveniences afforded by digital images.

The results from the survey of academic deans tended to reinforce the results from the semistructured interviews. All 18 of the survey respondents indicated that faculty members at their institutions used digital images. The academic deans indicated that their faculty members gathered images from the Internet, personal collections, digital journal articles and textbooks, and from commercial products on CD and DVD (see figure 1). (No respondents chose digital journal articles as a source for images, so that choice was omitted from figure 1.) This pattern of use clearly demonstrates the desirability of digital delivery of images. For example, even though all but one of the deans indicated that faculty members at his or her institution used images from personal collections, two thirds (12 of 18) also indicated that faculty members looked for free images on the Internet, and slightly more (13 of 18) looked for images on commercial DVDs or CDs. The use of commercial products, and the problems with image quality and variety that accompany that use, underlines the need for royalty-free images.

The respondents in the longer national survey also demonstrated a lack of satisfaction with their current access to dental images. Table 2 shows that among the respondents who indicated their level of satisfaction with the current access to dental images, none indicated complete satisfaction. A significant minority expressed an outright lack of access to all the images they needed.

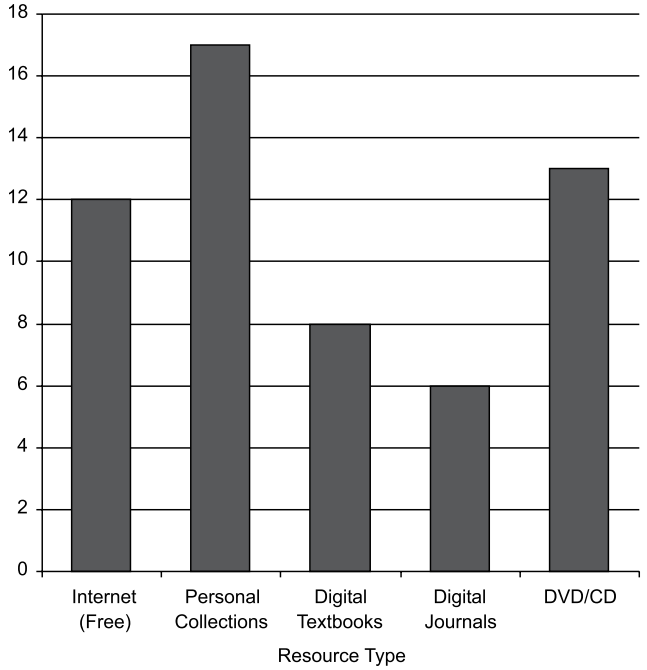

Figure 1. Sources of images

To summarize, the needs expressed by the respondents fell into three basic groups, all of which could be at least partially addressed by creation of a repository of digitized dental images:

1. Image Quality
2. Variety of Images
3. Image Cost and Intellectual Property

Table 2. Access to images

Please choose the item which best describes your use of images similar to the samples you saw on the previous page (*N*=50)	N	%
I have access to all the images I need	0	0
I have access to all the images I need, but having access to more images would be useful	30	60
I do not have access to all the images I need	20	40

RQ2: Can The Respondents' Needs Be Met by the Creation of an Online Repository of Digitized Dental Images?

Despite already having access to dental images, the faculty members still experienced the needs listed in the previous section. The creation of a repository of digital dental images could at least partially meet those needs.

Image Quality

A number of the interview respondents indicated a need for higher-quality images. For example, R15 indicated that, "Sometimes the pixel range is such that you can't enlarge them as you'd like," and that at times "color quality" also hindered the use of digital images. R14 pointed to a similar problem: "If you take a low-resolution image off of one of these web sites, and I then I take it to where I give the lecture, . . . that lack of resolution is magnified." The respondents also confessed to lack of technical expertise in some cases. For example, R08 said, "I'm not really well-versed in say, Adobe Photoshop, or things like that." Professional digitization of the images in the school's collection could address this need directly. Professionally digitized images based on the physical slides could be produced at high resolution and color quality, reducing the need to alter the images and making the alterations less significant when they are needed—for example, simple cropping rather than color adjustment.

Variety of Images

Another set of problems that could be addressed through the construction of an online repository of digitized dental images have to do with a desire on the part of some of the dental faculty members for a greater variety of images. When asked about the variety of available images, R08 answered, "There is a lot out there, I could be satisfied but I would like to see more diversity." The images in the school's collection depict a range of tissue from the maxillofacial region, in healthy condition as well as in diseased or damaged condition. The conditions depicted are commonly addressed in dental education, and would add to the variety of images available to dental educators and researchers. In addition, all eighteen of the deans indicated that their faculty members would benefit from access to high-quality digital images available royalty-free on the Internet.

Image Cost and Intellectual Property

R16 pointed to difficulties with image ownership and intellectual property:

> Multiple images, if there were some color atlases available that one could maybe draw some out. But there are only so many atlases, many times you do a search and you find that there is an atlas . . . at a web site or someone is selling and maybe it's $250 and they may have one or two pictures but you can't copy the pictures often from the web site. I mean sometimes you can but often you really can't and even if you're copying it is that really legal?

In addition to copyright issues, the interview respondents also pointed to concerns about gaining permission to use the images they already possessed. For example, R01 indicated that "I have quite a few images that I don't have the patients' permission that would now be required." The school's collection would be made available through a Creative Commons license (http://creativecommons.org) that would allow royalty-free image use for educational purposes. The license would also allow alteration of the pictures. HEAL currently makes its contents available through a Creative Commons license, so there would be no intellectual property barriers to inclusion of the school's collection.

The results from the larger national survey also indicated that dental faculty members would make use of an online repository of digitized dental images. As indicated in table 3, when asked whether they would be likely to use such a repository, a very large majority of the respondents to the question indicated that they would.

The longer national survey also demonstrated that the digitized dental images would be used for a variety of purposes. Table 4 lists the purposes for which the respondents

Table 3. Likelihood of repository use

Likelihood of Use (*N*=47)	N	%
Very likely	28	59.6
Somewhat likely	17	36.2
Somewhat unlikely	2	4.3
Very unlikely	0	0

Table 4. Purposes for which respondents used images

(*N*=52)	N	%
Teaching	50	96.2
Diagnosis	13	25
Research	7	13.5
Clinical consultations with patients	17	32.5

used dental images. The respondent could choose more than one purpose, so the percentages add to more than one hundred. Teaching predominated among the types of image use, but substantial minorities of respondents also used dental images for other purposes.

RQ3: What Functional Elements of the Proposed Online Repository of Digitized Dental Images Would Be Most Helpful to Users?

The longer national survey included questions that asked respondents to rate, on a five-point Likert scale, the usefulness of potential image characteristics and accompanying material, and potential metadata elements. Table 5 shows the respondents' rating of particular image characteristics and accompanying material. The list was built inductively on the basis of the earlier semistructured interviews and discussions with colleagues in the BA School of Dental Medicine. All of the items received a score of at least four, with the images of diseased or damaged tissues receiving the highest scores. But the scores for the potential accompanying materials were nearly as high, lagging by small fractions of a point.

Table 5. Ratings of potential image characteristics

5=most useful, 1=least useful	N	Mean
Images of healthy tissue	49	4
Images of diseased tissue	50	4.72
Images of injured or damaged tissue	50	4.54
Before, during, and after sequences to depict healthy tissue, diseased or damaged tissue, and healed tissue	50	4.62
Case studies, when available, to accompany images	49	4.67
Case information (patient age, gender, race/ethnicity, etc.) when available, to accompany images	49	4.51
Annotations, when available, to provide information such as the area of the maxillofacial region or the name of a disease or injury depicted in the image	50	4.52
Image files of sufficient quality and size so that they can be manipulated by cropping, color adjustment, etc.	49	4.57
Multiple images to depict various views of manifestations of the same tissue, disease, or injury, rather than a single image	50	4.36

The respondents were asked a similar set of questions about potential metadata elements. Table 6 shows the results. Various forms of textual descriptions garnered the highest scores, and subject descriptors garnered the lowest scores. It is worth noting, though, that the subject descriptors received scores in the middle of the scale, suggesting that they might have some positive value to the respondents.

Table 6. Ratings of potential metadata elements

5=most useful, 1=least useful	N	Mean
Textual description of the location in the maxillofacial region depicted in the picture	47	4.09
Clickable map or maps in the maxillofacial region to indicate the anatomical area depicted in the image	47	3.72
Textual description of tissue depicted in the image (e.g., lips, gums)	47	3.87
Textual description of the color of diseased tissue depicted in the image (e.g., color of lesion)	46	3.63
Clickable color palette to indicate the color of diseased tissue depicted in the image (e.g., color of lesion)	47	3.34
Textual description of a disease depicted in the image	47	4.13
Textual description of the disease stage depicted in the image	47	4.17
Textual description of damage to the tissue depicted in the image	47	4.09
SNODENT descriptor	28	3.14
MeSH descriptor	32	3.25

RQ4: Would Members of the Larger Dental Community Be Willing to Contribute Further Material to the Proposed Online Repository of Digitized Dental Images?

The longer national survey included a question about whether respondents would be willing to contribute images and accompanying material to the proposed online repository of digitized dental images. Table 6 shows the results. Very few respondents indicated a complete unwillingness to contribute to the proposed repository. A very large majority indicated either a current willingness to contribute or a potential willingness to contribute material given further information.

Conclusions

The results from both the interviews and the survey make it clear that use of dental images is nearly ubiquitous among dental faculty members. This reinforces anecdotal impressions of teaching activity in the field, and makes it clear that image use by dental faculty members should be considered a key element in planning for dental education. The interview respondents strongly preferred digital to nondigital images. Digital images were more convenient to use and custom-

ize, and minor compromises in image quality did not affect the interview respondents' overall use of, or preference for, digital images. But not all of the faculty members' current needs are being met. The unmet needs fell into three basic areas: image quality, variety of images, and image cost and intellectual property.

The faculty members expressed a desire for higher quality images that would allow for easier and more effective manipulation of the images (for example, by increasing their size for projection or viewing small sections of an image close up), for a greater variety in the images available, and for images that were freely available for educational and research use. All of these needs can be met at least partially by professionally digitizing the school's slides and making them available online under a Creative Commons license. The academic deans who responded to the survey also indicated that an online repository of digitized dental images would be useful for faculty members at their institutions. Fortunately, the infrastructure for accomplishing this already exists at HEAL, and HEAL has shown preliminary willingness to include the school's collection.

The respondents indicated a strong desire for a collection of diverse, high-quality images accompanied by supporting material such as annotations or case studies. Those needs could be at least partially met by an online repository of digitized images accompanied by relevant supporting materials such as annotations or case studies. The donated collection at the UB School of Dentistry currently contains only slides without annotations or case studies, but the information about potential metadata elements would be useful in planning the addition of annotations as part of the digitization project.

The respondents indicated a willingness to contribute both images and accompanying material, although the willingness was tempered by a desire for more information. Only a very small number of respondents gave an outright negative response. Providing clear rights based on a Creative Commons license may address at least some of the concerns expressed by respondents who wanted more information.

This needs assessment found a variety of unmet, image-related needs on the part of dental faculty members and researchers at North American dental schools. The allocation of resources to an online repository of digitized dental images could provide a significant aid to those faculty members and researchers by providing a wider variety of high-quality, manipulable, legal-to-use images that could enhance their established teaching efforts. The infrastructure for the delivery of the images already exists at HEAL, and the images from the school's collection can be effectively incorporated into that existing infrastructure.

The needs assessment also helped determine a preliminary set of potential metadata elements and accompanying material to go with the images. The donated collection at the UB School of Dentistry currently includes images only, but external funding would make annotations feasible, and even without funding simple annotations could also be added as part of the digitization process through brief labels for the digitized images.

The research team also hoped that the university's collection could act as a kernel for a larger collection. The preliminary indications are positive, and provide evidence that a pool of faculty and researcher contributors exists.

The multistage needs assessment described in this paper was subject to several limitations. The sample size, even for the longer survey, was relatively small. In addition, there was attrition on individual questions. But it is unlikely that the needs expressed were unique to the respondents. Image quality, rights to use images, and image variety are likely to be common problems in dental education, and other professions as well.

The current lack of annotations in the donated collection is a negative factor, but the simple presence of high-quality images of diseased, injured, and healthy tissue was also important to the respondents. External funding for extensive annotation would be extremely helpful, but simple labels provided during the digitization process would suffice to start the collection.

At a minimum, this needs assessment established that there is an appreciable body of dental faculty members and researchers whose image-related needs could be at least partially met through the establishment of an online repository of digitized dental images.

While the research project described in this paper had a very specific focus—assessing digital image use and needs in

Table 7. Willingness to contribute to repository

47 responses to each question	Images		Annotations		Case Studies	
	N	%	N	%	N	%
Yes	24	51.1	18	38.3	18	38.3
No	0	0	2	4.3	1	2.1
Maybe, but I would need more information before deciding	23	48.9	27	57.4	28	59.6

dental education, the process can be applied to understanding digital image use and needs in other fields. Gathering data through a similar process can inform planning for digital repositories of all types.

References

1. Titus K. L. Schleyer et al., "The Technologically Well Equipped Dental Office," *Journal of the American Dental Association* 134, no. 1 (2003): 30–41; Paul Feuerstein, "Can Technology Help Dentists Deliver Better Patient Care?" *Journal of the American Dental Association* 135, suppl. 1 (2004): 11S–16S.
2. William D. Hendricson et al., "Electronic Curriculum Implementation at North American Dental Schools," *Journal of Dental Education* 68 (2004): 1042.
3. William D. Hendricson et al., "What Do Dental Students Think About Mandatory Laptop Programs?" *Journal of Dental Education* 70, no. 5 (2006): 481.
4. Schleyer et al., "The Technologically Well Equipped Dental Office," 30.
5. Feuerstein, "Can Technology Help Dentists Deliver Better Patient Care?"
6. Michael Kirshner, "The Role of Information Technology and Informatics Research in the Dentist-Patient Relationship," *Advances in Dental Research* 17 (2003), http://adr.iadrjournals.org/cgi/content/full/17/1/77 (accessed Oct. 1, 2007).
7. Steinar Kvale, *Interviews: An Introduction to Qualitative Research Interviewing* (Thousand Oaks, Calif.: Sage, 1996).
8. Jacob Cohen, "A Coefficient of Agreement for Nominal Scales," *Educational and Psychological Measurement* 20 (1960): 37–46.
9. Jean Carletta, "Assessing Agreement on Classification Tasks: The Kappa Statistic," *Computational Linguistics* 22, no. 2 (1996): 249–54.
10. Michael D. Kaplowitz, Timothy D. Hadlock, and Ralph Levine, "A Comparison of Web and Mail Survey Response Rates," *Public Opinion Quarterly* 68, no. 1 (2004): 94–101.

Appendix A. Instrument for Semistructured Interviews

Part 1: General Use of Digital Resources

1. Please indicate whether you use each of the following resources as part of your professional work:
   _____ Internet search engines, e.g., Google.
   _____ Online dentistry resources owned or maintained by the university.
   _____ Online dentistry resources NOT owned or maintained by the university.
   _____ Online databases, e.g., MedLine.
   _____ Information on CD-ROM or DVD.
   _____ Other, e.g., information delivered to a personal digital assistant (PDA) or other electronic device.
   1a. [For each resource used] Under what circumstance or circumstances do you typically use [resource]?
      1a1. [For each circumstance] Why do you use [resource under circumstance]?
      1a2. Are there any other circumstances under which you use [resource]?
      1a3. Have you experienced any problems or shortcomings with [resource] that hinder your use of [resource] in any way?
      1a3b. [If YES] Can you describe those problems or shortcomings, and how they hinder your use of [resource]?
   1b. [If no resources used] Can you tell me why you choose not to use any of the resources I listed?

Part 2: Use of Dental Images

2. Do you currently make use of the kinds of dental images that I have shown you?
   2a. [If YES] What types of images do you use?
      2a1. [For each type] Under what circumstances do you typically use [type]?
         2a1a. In what form do you usually use [type]?
         2a1b. [For each form] Why do you use [type] in [form]?
      2a2. [For each type and form] Have you experienced any problems or shortcomings with [resource in form x] that hinder your use of [resource] in that form any way?
         2a2a. [If YES] Can you describe those problems or shortcomings, and how they hinder your use of [resource in form x]?
      2a3. Do you have access to the full range of dental images that you would like to use as part of your professional work?
         2a3a. [If NO] Can you tell me what images or kinds of images you currently do not have access to, but would like to have access to?
   2b. [If NO] Can you tell me why you choose not to use the kind of dental images I showed you?

Part 3: General Follow-up

3. Are there other ways in which you use digital resources as part of your professional work that we haven't talked about?
   3a. [If YES] Can you explain what those other way of using digital resources are?
4. Are there other ways in which you use dental images as part of your professional work that we haven't talked about?
   3a. [If YES] Can you explain what those other way of using dental images are?

Appendix B. Survey Sent to Academic Deans

Q1: Do your faculty use digital images to teach dentistry?
Yes _____ No_____

Q2: If so, what resources provide images for faculty use? Please check all that apply
A: Internet (free)
B: Personal Faculty Collections
C: Subscriptions such as DERWeb
D: Digital Textbooks
E: Digital Journal Articles
F: Commercial DVD/CD (Supplied by companies)

Q3: Do you believe that your faculty would benefit from and utilize a copyright free source of digital images in oral pathology/oral medicine and histology available for desktop delivery via the Internet?
Yes _____ No_____

Appendix C. Second Survey Instrument

Note: On the list of answers an open circle indicates a radio button, a hollow square indicates a checkbox, and a solid square indicates an item on a list.

I. General Background
[Note: Sample images placed here on Web instrument.]

A. Do you make use of images of healthy, diseased, or damaged tissue in the maxillofacial region like the ones shown here?
   - ○ YES
   - ○ NO [Send user straight to Thank You screen if answer is No.]

B. Please choose the item which best describes your use of images similar to the samples you saw on the previous page:
   - ○ I have access to all the images I need, and I don't want more.
   - ○ I have access to all the images I need, but having access to additional images would be useful.
   - ○ I do not have access to all the images I need.

C. I use images for the following purposes (choose all that apply):
   1. Teaching
   2. Diagnosis
   3. Research
   4. Clinical consultations with patients
   5. Other: _____

D. Please choose the option that best describes your professional situation:
   - ○ I am a full-time tenure track/tenured faculty member at a dental school.
   - ○ I am a full-time clinical faculty member at a dental school.
   - ○ I am a part-time clinical faculty member at a dental school.
   - ○ Other: _____

II. Image Characteristics

A. Please indicate, on a scale of 1–5, how useful each of the following elements would be in your use of the proposed

repository, with 5 being most useful and 1 being least useful. [Radio buttons 5–1 for response]

- Images of healthy tissue. Images of diseased tissue.
- Images of injured or damaged tissue.
- Before, during, and after sequences of images to depict healthy tissue, a disease or injury to that tissue, and healed tissue.
- Case studies, when available, to accompany images in the collection.
- Case information (patient age, gender, race/ethnicity, etc.), when available, to accompany images in the collection.
- Annotations, when available, to provide information such as the area of the maxillofacial region or the name of a disease or injury depicted in an image.
- Image files of sufficient quality and size so that they can be manipulated by cropping, color adjustment, etc.
- Multiple images to depict various views or manifestations of the same tissue, disease, or injury, rather than a single image.
- Other: [Text box for description]

B. The next set of questions asks about *access points* that might be used in the proposed repository of digitized dental images. An access point is any path that you might use to find an image. For example, pointing and clicking on a map of the maxillofacial region to find images depicting tissue in that region, or performing a text search based on annotations accompanying the images, could serve as examples of potential access points.

Please indicate, on a scale of 1–5, how useful each of the following access points would be in your use of the proposed online repository of digitized dental images, with 5 being most useful and 1 being least useful. [Radio buttons 5–1 for response]

- Textual description of the location in the maxillofacial region depicted in the image. Clickable map or maps in the maxillofacial region to indicate the anatomical area depicted in the image.
- Textual description of tissue depicted in the image (e.g., lip, gums).
- Textual description of the color of diseased tissue depicted in the image (e.g., color of lesion).
- Clickable color palette to indicate the color of diseased tissue depicted in the image (e.g., color of lesion).
- Textual description of a disease depicted in the image.
- Textual description of the disease stage depicted in the image.
- Textual description of damage to the tissue depicted in the image.
- SNODENT [Systematized Nomenclature of Dentistry] descriptor.
- MeSH subject heading.
- Other: [Text box for description]

III. Final Questions

A. How likely would you be to make use of an online repository of digitized dental images that would be freely available under a Creative Commons license for research, teaching, and diagnosis?

- ○ Very likely
- ○ Somewhat likely
- ○ Somewhat unlikely
- ○ Very unlikely

B. Would you be willing to contribute images to an online repository of digitized dental images that would be freely available under a Creative Commons license for research, teaching, and diagnosis?

- ○ Yes
- ○ No
- ○ Maybe, but I would need more information before deciding.

C. Would you be willing to contribute annotations to an online repository of digitized dental images that would be freely available under a Creative Commons license for research, teaching, and diagnosis?

- ○ Yes
- ○ No
- ○ Maybe, but I would need more information before deciding.

D. Would you be willing to contribute case studies to an online repository of digitized dental images that would be freely available under a Creative Commons license for research, teaching, and diagnosis?

- ○ Yes
- ○ No
- ○ Maybe, but I would need more information before deciding.

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