Informatics Training in Pathology Residency Programs

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Abstract

Information management is crucial in pathology, and previous reports have stressed the need for improved informatics training in pathology residency programs. We surveyed 150 US programs to assess informatics training with respect to types of training, proficiency expectations, and computing infrastructure. Seventy-two programs (48.0%) responded. Of the respondents, 67 (93%) reported offering informatics training; of these, 52 (78%) required it. Most programs integrated informatics into another rotation, usually management. In 37 programs (55%), the amount of informatics training has increased during the last 3 to 5 years. The most common instructional methods were hands-on training and self-study; 61 programs (91%) used multiple methods. In all but 2 programs, computers were designated for residents; 9 programs offered individual computers to residents. All programs provided productivity software. These data suggest progress in informatics training but that considerable room for improvement exists. Our data also document for the first time detailed computing resources available to residents.

The fundamental mission of the medical discipline of pathology is to provide information that is used for diagnostic, prognostic, and therapeutic purposes in pursuit of patient care. Effective information management and optimized information systems are crucial to the successful practice of pathology with respect to this mission. Pathology informatics refers to the theory, practice, and investigation of electronic information management in anatomic and clinical pathology.

The aim of residency training programs is to provide training in all aspects of pathology. Persons completing the program are expected to function with the highest degree of competency. It follows from the mission of pathology and the purposes of pathology training that an acquisition of baseline knowledge in pathology informatics should be an important part of residency experience in pathology.

Even before the current “information age,” the importance of computerized information management in pathology and pathology training was recognized.1-5 Previous conferences and reports6,7 have stressed the need for improved informatics training in pathology residency programs. Many of these reports also outlined recommendations for aspects of informatics training that should be part of residency training programs.

We report the results of a survey of pathology informatics training and infrastructure in pathology residency programs. The survey was conducted to assess the state of pathology informatics training at a time when the attention focused on informatics in pathology has never been greater. Part of the intent was to evaluate progress relative to findings and recommendations from previous surveys8,9 and conferences.6,7 This survey also reports new data about informatics-related expectations placed on current
Residents and, to our knowledge, is the first detailed evaluation of the hardware and software infrastructure available in residency programs.

Materials and Methods

In May 2000, a letter requesting participation in an online, World Wide Web–based survey of residents’ informatics training and computing infrastructure was mailed to 150 US pathology residency program directors. All US programs listed in the Directory of Pathology Training Programs received the letter. The survey response form was developed using Web-enabled relational database management software (FileMaker Pro, FileMaker, Santa Clara, CA) and was posted on the World Wide Web at http://pathology.creighton.edu/survey. The survey form is illustrated in Figure 1.

Each program was given a unique program identification number and password for access to the survey and could view only its own responses. All individual responses were kept confidential. The estimated time to complete the survey was less than 20 minutes. The letter indicated to participants that the summarized data would be published following analysis. In August 2000, a second request letter was mailed. Response data were analyzed using database management and spreadsheet software systems (Filemaker Pro; Access and Excel, Microsoft, Redmond, WA).

Results

Curriculum

Seventy-two programs (48.0%) responded to the survey. Of the 72 programs, 67 (93%) indicated that some type of formal training in informatics is provided. Several training programs indicated that informatics training was not offered and did not complete the remainder of the survey; these were counted as respondents, but the percentages reported are

![Figure 1](image_url) Screen capture from on-line survey form. ID, identification; LIS, laboratory information system.
based on the number of programs indicating that informatics training was offered. Of the 67 programs offering informatics, 52 (78%) indicated that informatics training is required. Thirteen programs (19%) offer informatics as a dedicated rotation. In the remainder, informatics is integrated into other rotations, most commonly management (29 programs [43%]), orientation (7 programs [10%]), and chemistry (4 programs [6%]). Thirteen programs (19%) indicated that informatics is part of many or all rotations in general training, and another 8 programs include informatics as part of more than 1 rotation. In 37 programs (55%), the amount of informatics training has increased during the past 3 to 5 years, while in 30 programs (45%), the amount of informatics training has not changed substantially. No program indicated that the amount of informatics training had decreased. Thirteen programs (19%) formally assess informatics competency as part of the training program.

In most programs, multiple instructional methods are used for informatics training. The most commonly cited method was hands-on experience with desktop computers (57 programs [85%]), followed closely by self-directed study (56 programs [84%]). In 25 programs (37%), staff from other departments provided some aspects of informatics training.

Of 67 programs offering informatics training, 65 (97%) indicated that they provide orientation to the laboratory information system (LIS), and in 47 (70%), this orientation is formal training. Fifty-four programs (81%) responded that their residents’ experience requires daily interactions with the LIS. Ten programs (15%) offering informatics training indicated that the informatics training is restricted to LIS orientation and training.

Regarding other informatics-related experiences, residents perform digital imaging in 57 programs (85%) and use presentation graphics (eg, Microsoft PowerPoint, Microsoft) in 63 programs (94%). Sixty-two programs (93%) indicated that e-mail is used for intradepartmental communications.

**Infrastructure**

All 67 programs offering informatics training reported that at least 1 computer is available for resident use. Nine programs (13%) provide residents with their own individual computers. In programs in which residents share computers, the number of computers dedicated to residents ranged from 1 to 30, with an average of 6.8 per program. The distribution of computing platforms available (ie, Apple Macintosh vs Microsoft Windows/IBM-compatible) is given in Figure 31. In 63 programs (94%), the residents’ personal computers are in a networked environment, and in 41 programs (61%), residents have access to space on a file server. In 44 programs (66%), printers are dedicated to resident use.

All programs provide word-processing software to residents, and the majority provide other basic productivity software, including spreadsheet and presentation graphics. Figure 41 gives the distribution of software applications provided to residents. Internet access is provided in all but 1 program, and e-mail is provided in 63 programs (94%). Eight programs (12%) restrict the use of e-mail and/or the Internet in some manner.
Our survey represents the third published survey of informatics training in residency programs but is the first since 1997. The goal of the present survey was to assess the state of informatics training in pathology programs concurrent with the explosion of the information age, advances in technology, and the generally increased emphasis on informatics in pathology practice. The attention focused on informatics in pathology has never been greater. A new organization, the Association for Pathology Informatics, has been established with the intent of promoting pathology informatics as an academic discipline and a clinical subspecialty of pathology. Courses focusing on informatics have in recent years become increasingly prominent at national pathology society scientific meetings.

Informatics training encompasses knowledge objectives and computer-related proficiencies, or skill sets. Our survey addresses both of these areas. The survey data offer insight into progress that has occurred relative to previous recommendations on this topic. Our survey also provides more detailed data about the software and hardware infrastructure available to residents and about the computer-related competencies now expected of residents.

The vast majority of programs responding (62 programs [93%]) offer formal informatics training. The percentage of programs offering informatics training in our survey is largely in line with those reported in earlier surveys. This percentage may be an overestimate of the true percentage of programs offering formal informatics training, because programs offering such training may have been more likely to respond to a survey on this topic, particularly a survey that is Web-based, and this bias could inflate the percentage somewhat. If the true percentage of programs offering informatics training is indeed lower, then there is even more progress that remains to be made because informatics training is not as pervasive as our survey suggests.

Our data indicate that a variety of instructional methods are used and that most programs use more than 1 instructional method. Many use staff from other departments to provide instruction in informatics. Few programs (13 [19%]) indicated that they formally assess trainees’ informatics competency. There is no evidence from the survey that a standard or core informatics curriculum for pathology trainees has been developed or adopted in most programs. Almost all programs provide orientation to the LIS, and, in most cases, this orientation is formal training. Encouragingly, the number and type of hardware and software tools available to residents seem to have increased.

Previous conferences and task forces have recommended that informatics training in pathology residency occur both as a dedicated rotation and as experience integrated into all rotations. The desirability of the latter approach should be intuitive, given the crucial role of information management and information systems in the success of all aspects of the laboratory. Comparison of our results with those reported previously is given in Table 2. Compared with previous surveys, the proportion of programs offering dedicated informatics rotations has decreased somewhat. Most programs integrate informatics training into another rotation, with management rotations being the most commonly cited, as in previous surveys. Most programs still do not integrate informatics training into all rotations or general training, although our results suggest some progress in the sense that 13 programs (19%) specifically mentioned that informatics training is part of all rotations or of general anatomic pathology and clinical pathology training, and another 8 programs incorporate informatics training into more than 1 rotation. In addition, in the vast majority of programs (54 [81%]), daily use of the LIS is required of residents on various rotations. These latter data provide a baseline to assess future progress toward incorporating informatics experiences into general pathology training.

In addition to knowledge objectives related to terms, concepts, and theory of informatics, training in informatics encompasses proficiency in skills related to the use of computing tools (computers and peripheral devices) that are integral to pathology practice. A concern raised in the previous studies that persists in our analysis is the notion that many programs view informatics training as restricted to the use of LIS and, perhaps, the use of personal computers, without the knowledge objectives or exploration of the applications of informatics in pathology practice. The authors raised this point in the context of a large proportion of programs using hands-on use of the personal computer as the...
Henricks and Healy / Pathology Informatics Training Survey

Table 2
Comparison of Present Survey Results With Those From Previous Studies*

<table>
<thead>
<tr>
<th></th>
<th>Present survey, 2001</th>
<th>Goldberg-Kahn and Healy,9 1997</th>
<th>Balis et al,8 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of programs surveyed</td>
<td>150</td>
<td>176</td>
<td>209</td>
</tr>
<tr>
<td>Responses</td>
<td>72 (48.0)</td>
<td>84 (47.7)</td>
<td>142 (67.9)</td>
</tr>
<tr>
<td>Informatics offered</td>
<td>67 (83)</td>
<td>74 (88)</td>
<td>119 (83.5)</td>
</tr>
<tr>
<td>Informatics required</td>
<td>52 (78)</td>
<td>57 (77)</td>
<td>70 (58.8)</td>
</tr>
<tr>
<td>Dedicated rotation</td>
<td>13 (19)</td>
<td>20 (27)</td>
<td>37 (31.1)</td>
</tr>
<tr>
<td>Hands-on</td>
<td>57 (85)</td>
<td>64 (86)</td>
<td>77 (64.7)</td>
</tr>
<tr>
<td>Tutor</td>
<td>41 (61)</td>
<td>47 (64)</td>
<td>37 (31.1)</td>
</tr>
<tr>
<td>Self-instruction</td>
<td>56 (84)</td>
<td>48 (65)</td>
<td>41 (34.5)</td>
</tr>
<tr>
<td>Lectures</td>
<td>46 (69)</td>
<td>43 (58)</td>
<td>63 (52.9)</td>
</tr>
<tr>
<td>Reading materials</td>
<td>40 (60)</td>
<td>42 (57)</td>
<td>—</td>
</tr>
</tbody>
</table>

* Data are given as number (percentage). For rows following “Informatics offered,” percentages are based on the number of programs offering informatics.

only or the main component of informatics training. We are encouraged by our finding that although a high percentage of programs still report that personal computer use is a main method of training, all but 6 programs (9%) report using more than 1 method of training, with more than half using 4 or 5 different instructional methods.

New in this survey are data that indicate that computer-related proficiency beyond just the use of the LIS is now expected of residents. In the great majority of programs, residents perform digital imaging, and in nearly all programs, residents use presentation graphics (e.g., PowerPoint) for conferences. Of 67 programs, 62 (93%) reported that they use e-mail for routine intradepartmental communications. Additional comments from individual programs indicated that residents are expected to produce posters in digital form for scientific meetings and to use spreadsheets for data analysis on rotations. These data suggest that baseline proficiency skill sets for residents are increasing beyond just use of the LIS. In addition to making the appropriate tools available to residents, training programs should make available basic training for skill sets such as these that are increasingly required as part of pathology practice and research, because it cannot be assumed that all incoming residents possess these abilities. At the same time, the realization should exist that many trainees now enter programs with these abilities and will not need such basic training and that informatics training must be more than use of the LIS and personal computer productivity tools.

In addition to assessing the informatics curriculum in training programs, our survey also collected data about computing infrastructure that is available to residents. Hardware, in particular access to a personal computer, and software tools are now crucial parts of pathology practice in general and are a foundation for informatics training. All programs offering informatics training that responded indicated that at least 1 personal computer was available for resident use, with an average of 6.8 residents’ computers per residency program. In all but 2 of these programs, computers were dedicated for resident use. These other 2 programs mentioned that large numbers of computers were available but were not specifically designated for resident use. These data are encouraging compared with those reported by Goldberg-Kahn and Healy,9 who earlier reported data about personal computers available to residents. These authors documented a substantial proportion of programs reporting that computers were not supplied for the exclusive use of residents. The number of programs supplying individual computers to residents, however, remains very low, although it has increased (from 6 to 9). Our results also indicate that the preferred computing platform has shifted somewhat, with a greater proportion (66% compared with 44%) of programs reporting the use of Windows-based (Microsoft) computers exclusively. This shift probably reflects, in part, the fact that LISs are deployed increasingly on Windows-based operating systems and often are not Macintosh-compatible. Macintosh computers, though, are still used in a substantial percentage (about 34%) of departments.

Our survey systematically documents data not previously reported about the hardware infrastructure available to residents. Of 67 programs, 63 (94%) reported that their residents’ computers were in a networked environment. Access to a network is necessary for file sharing and transfer, communications, and Internet access. Forty-one programs (61%) reported that dedicated space on a file server is available to residents. Server space in a networked environment is highly desirable because it eliminates reliance on inconvenient floppy disks, permits easier management of and access to large files (e.g., digital images, presentations), and facilitates regular backup of files from the server. Finally, almost two thirds of programs supply printers dedicated to resident use. Given the expectations of residents (such as those noted herein) and the increasing reliance on word-processing and spreadsheet programs, dedicated printers for resident use are becoming more of a necessity than a convenience.

Our data are the first systematic reporting, to our knowledge, of software applications that are provided to
residents. Just as is the case with the computer itself, software applications are tools that are required for one to function as a resident and pathologist and that are necessary for informatics training. The majority of training programs provide productivity applications to residents with word processing available in all programs and spreadsheet and presentation graphics provided in almost all programs. A lower proportion (though still a majority) provides database, statistics, and image-editing applications. Database theory and development and digital image capture and editing are important elements of pathology informatics, and having such software available would facilitate residents’ informatics knowledge and proficiency. We were surprised, given the need for residents to access clinical data, that only 51 programs (76%) stated that they provide LIS/hospital information system access (which can be readily accomplished through use of terminal emulators for miniframe- or mainframe-based systems) on computers dedicated to residents’ use.

The data about the hardware and software infrastructure available to residents reflects only the programs offering informatics training (since the few programs responding that informatics training was not offered did not complete the infrastructure portion of the survey). Our data, though, probably are at least reflective of residents’ computing resources in general. It is reasonable to suggest that the computing infrastructure available to residents would not be dramatically better in programs not offering informatics training than it is in programs that do.

Pathologists finishing training must be versed in informatics, in terms of fundamental knowledge and skill sets. Sinard and Morrow11 described a scenario in which informatics has a crucial part in the future success of the field of pathology. In this vision, the pathologist retains the central role as diagnostic specialist by integrating data streams coming from multiple diverse sources, new technologies, and decision support systems. Gorstein and Weinstein12 also have advanced similar points in a reexamination of pathology residency training. These authors cited numerous examples of how informatics is currently and will be further woven into medical and pathology training. We agree with these authors and others before them1-5 that the importance of informatics in pathology practice not only will increase but also will be necessary for the success of pathology as a medical discipline.

Appendix 1
Questions on Survey of Informatics Training in Pathology Residency Programs

All questions are yes/no unless otherwise noted or if the question requires a text or numeric answer.

1. Is informatics training offered?
2. Is informatics training required?
3. Is informatics a dedicated rotation?
4. If so, what length?
5. If informatics is not dedicated, what is it a part of (eg, management)?
6. Residents are trained hands-on with desktop computers?
7. With tutor?
8. With readings?
9. Self-/independent study?
10. With lectures?
11. Other methods are used? (please specify)
12. Is there a recommended reading list?
13. Are projects (eg, research) part of the training?
14. Please describe the types of projects.
15. Is an LIS orientation provided to residents?
16. Is this LIS orientation formal?
17. Is informatics training restricted to LIS training only?
18. Do residents interact with staff from other academic departments (eg, computer science) as part of informatics training?
19. Please provide any other comments about interactions with other departments.
20. Are residents required to use LIS daily?
21. Do you formally assess informatics competency?
22. If so, please describe assessment methods.
23. How has informatics training changed? (Increased/ Decreased/About the Same)
24. Now offered?
25. Now required?
26. Now dedicated?
27. Please provide any other comments about how your informatics training program has changed.
28. How many residents have their own computer provided by the department?
29. How many computers that the residents use for day-to-day computing are shared with other residents or others in the department?
30. If residents have computers provided by the department (either their own or shared with other residents), how are they provided? (New/Hand-Me-Down/Both)
31. Number of Macintosh computers used by residents
32. Number of Windows computers
33. Number of other types of computers
34. Are resident computers networked?
35. Do residents have their own file server space?
36. Do residents have their own dedicated printers?
37. Do residents use word processing programs?
38. Use spreadsheets?
39. Use presentation graphics?
40. Use database programs?
41. Use statistics programs?
42. Use image manipulation and/or analysis programs (eg, Photoshop, NIH Image)?
43. Do residents perform digital imaging for research and/or routine presentations?
44. Do residents have LIS and/or HIS access from their desktops?
45. Please provide other comments about the hardware and software provided to or used by your residents.
46. Do residents have e-mail?
47. Does your department normally or routinely communicate via e-mail?
48. Do your residents have Web/Internet access?
49. Do you restrict or filter e-mail/Web access?
50. Do you have on-line pathology texts (eg, AFIP fascicles)
51. Does your department use presentation graphics (eg, PowerPoint) for routine conferences?
52. Please provide any other comments.

AFIP, Armed Forces Institute of Pathology; HIS, hospital information system; LIS, laboratory information system.
To address training and proficiency needs in pathology residency, we propose the following:

- Development of a core set of detailed learning objectives and skill sets in pathology informatics
- Dedication of adequate computing hardware and software resources and space to residents, particularly individual personal computers and file server access
- Formal evaluation of residents' informatics competency
- Incorporation of informatics-related experiences into all anatomic and clinical pathology rotations

These proposals are not entirely new, but they merit reiteration based on the results of our survey. While some progress is occurring toward improving informatics training and tools for pathology residents, more steps can be taken to ensure adequate preparation of the future practitioners of the specialty in this vital field.

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References


