

Original Article

Perceptions of pathology informatics by non-informaticist pathologists and trainees

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Abstract

Background: Although pathology informatics (PI) is essential to modern pathology practice, the field is often poorly understood. Pathologists who have received little to no exposure to informatics, either in training or in practice, may not recognize the roles that informatics serves in pathology. The purpose of this study was to characterize perceptions of PI by noninformatics-oriented pathologists and to do so at two large centers with differing informatics environments. **Methods:** Pathology trainees and staff at Cleveland Clinic (CC) and Massachusetts General Hospital (MGH) were surveyed. At MGH, pathology department leadership has promoted a pervasive informatics presence through practice, training, and research. At CC, PI efforts focus on production systems that serve a multi-site integrated health system and a reference laboratory, and on the development of applications oriented to department operations. The survey assessed perceived definition of PI, interest in PI, and perceived utility of PI. **Results:** The survey was completed by 107 noninformatics-oriented pathologists and trainees. A majority viewed informatics positively. Except among MGH trainees, confusion of PI with information technology (IT) and help desk services was prominent, even in those who indicated they understood informatics. Attendings and trainees indicated desire to learn more about PI. While most acknowledged that having some level of PI knowledge would be professionally useful and advantageous, only a minority plan to utilize it. **Conclusions:** Informatics is viewed positively by the majority of noninformatics pathologists at two large centers with differing informatics orientations. Differences in departmental informatics culture can be attributed to the varying perceptions of PI by different individuals. Incorrect perceptions exist, such as conflating PI with IT and help desk services, even among those who claim to understand PI. Further efforts by the PI community could address such misperceptions, which could help enable a better understanding of what PI is and is not, and potentially lead to increased acceptance by non-informaticist pathologists.

Key words: Education, fellow, pathology informatics, perceptions, resident

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INTRODUCTION

With recent growth in the use of electronic systems to generate and manage health care data and the availability of large biomedical datasets, the practice of pathology, alongside many other medical specialties, is poised for dramatic change. The discipline of pathology informatics (PI) has emerged in the context of this relative explosion of disease-, diagnostic-, and patient-related data. With emerging technologies such as predictive analytics and management of genomic information, pathologist informaticists can anticipate expanding opportunities for PI within pathology in general and within the healthcare setting.^[1]

Despite the growing importance of informatics in pathology, anecdotal experience suggests that the realm of PI remains misunderstood by pathologists. Pathologists may receive little to no exposure to PI in training,^[1-3] and what is taught may actually be more related to information technology (IT) than to informatics. Many pathologist informaticists can relate personal experiences involving requests from pathologists that are more appropriate for a technical help desk.

A divide among pathologists appears to exist between pathology informaticists (who view PI as integral to the specialty) and noninformatics-practicing pathologists (who demonstrate a possible lack of interest and understanding of PI). The purpose of this study was to examine this apparent difference in opinion within pathology. Pathologists at two large centers were surveyed, exploring themes such as perceived usefulness and relevancy of PI to personal practice, and perceived understanding of PI. Such findings could add to improved understanding of how PI stands within pathology.

For the purposes of this study, a strict, theoretical definition of PI was used as the working definition: i.e., at its very essence, the discipline is about the use, management, sharing and communication of information, which does not necessarily require technology as part of a solution. This strict definition thus includes older information management techniques present before the advent of personal computers. This working definition was used with the understanding that in recent years, the informatics discipline has become increasingly dependent on technology due to the need to automate and store today's massive amount of data. However, given the goals of the study, a clear definition of PI that excludes technology was needed.

Therefore, the working definition of the discipline focused on classical informatics theory and topics (such as knowledge representation and information retrieval). With this strict definition, IT and computer science domains such as software engineering are subject domains distinct from informatics – not part of the

informatics discipline itself, but frequently used tools to enable successful informatics efforts.

This definition thus does not require physicians to acquire IT skills such as assembling computer hardware or developing software, in order to become a competent informaticist. It is also aligned with the official American Medical Informatics Association definition, which states that biomedical informatics “builds on computing, communication, and information science,” treating them as distinct disciplines, as opposed to including them as part of its fundamental definition.^[4]

Help desk activities were defined as activities providing services such as assembling, setting up and troubleshooting computer hardware (e.g., a nonfunctioning keyboard and mouse), and installing desktop applications. Laboratory information system (LIS) support issues, such as resetting passwords or search requests are addressed by LIS analysts, and not by typical help desk employees. However, these activities were not considered part of the working definition of informatics used in this study.

METHODS

Pathology departments at two large academic medical centers that have substantially different departmental PI cultures were surveyed: Massachusetts General Hospital (MGH) in Boston, MA, and Cleveland Clinic (CC) Health System in Cleveland, OH. Differences in PI cultures between these two institutions are compared and contrasted later in the discussion.

It was decided to limit this initial study to two locations. Although the inclusion of more institutions and settings such as community practices might have added value and insight, the introduction of additional complexities to initial analysis was a possibility: For example, accounting for factors not shared by different types of settings, such as an academic center with a residency program compared to a small community group practice without residents, in drawing comparisons of survey responses. Initial findings from this limited study could contribute to and guide better study design for a subsequent effort involving more locations and settings.

To assess perceptions of noninformatics-practicing pathologists and pathology trainees (residents and fellows), a 17-question survey using SurveyMonkey (<http://www.surveymonkey.com>) was developed. Questions were designed to address three areas of focus: (1) Perceived definition of PI, (2) interest in PI, and (3) perceived utility of PI [Table 1]. The Likert format [inset, Table 1] was used for all questions except one. This particular question was designed to assess respondents' understanding of the differences between informatics and IT. It presented the respondent with a list of 15 activities and asked respondents to select those believed to be informatics

Table 1: List of all Likert-style survey questions, organized into three areas of focus

Perceived definition of PI	Interest in PI	Perceived utility of PI
I have a good understanding of what PI encompasses	Informatics is exciting	Pathologists need to be familiar with and knowledgeable in informatics
Experience in computer programming or writing code is essential to being involved in PI	My department values PI	I plan to use PI in my career
Providing computer help desk services for basic complaints not immediately related to lab operations is a part of informatics	My residency program places high value on PI education	I understand the importance of PI in my career
Pathology informaticians need to interact with other pathologists in their institution	I want to learn more about PI	I am not interested in using PI within my practice
		PI knowledge and skills will be an asset to my career
		A lack of PI knowledge and skills will not hurt my career
		I regard PI as a set of techniques for all pathologists to use, analogous to IHC
		I regard PI as a subspecialty to be practiced only by those with PI subspecialty training, analogous to medical kidney pathology

Q6: Informatics is exciting

- Agree
- Disagree
- Neither agree nor disagree

Inset: Example of Likert-style question. PI: Pathology informatics, IHC: Immunohistochemistry

activities. Four of the activities listed were computer help desk/pure IT situations such as troubleshooting desktop computer issues and installing new software programs on a desktop computer, which were intended as incorrect choices for informatics activities [Table 2]. An additional question asked respondents to identify themselves as a CC attending pathologist, CC pathology trainee, MGH attending pathologist, or MGH pathology trainee. The URL to the online survey, along with short description about it, was e-mailed to all pathology faculty and trainees at MGH and CC. Recipients were asked to self-exclude on the following basis: (1) Undergoing or have completed a PI fellowship, (2) actively publishing papers on informatics-related topics such as decision support or test utilization. Raw survey data was exported from SurveyMonkey to a Microsoft Excel spreadsheet for analysis.

RESULTS

One hundred and seven respondents completed the survey: 41 of 84 eligible CC attending pathologists, 28 of 51 CC pathology trainees, 26 of 98 MGH attending pathologists, and 12 of 47 MGH pathology trainees. The list of Likert questions with response breakdown, summary, and comments is presented as Supplementary Material.

Perceived Definition of Pathology Informatics

Just over half (54%) of all respondents felt that they understood what PI is. CC trainees had the lowest self-reported understanding, at 40%, in contrast to at least 50% of respondents in all other groups [Figure 1]. The non-Likert question described earlier in the methods section, intended to assess self-reported understanding of PI, resulted in interesting findings. Out of a total of fifteen listed activities, the eleven correct PI activities were chosen by a varying majority, ranging from 92% of respondents agreeing that “reduction in inappropriate

test ordering” is a part of PI, down to 56% agreeing that PI has a role in “Health Insurance Portability and Accountability Act compliance.” Four activities belonging to the computer help desk domain were included on the list. Many respondents selected these incorrect choices as well, of which “resolving technology problems with display of presentations” was the most popular choice, with 45% of respondents selecting. Interestingly, help desk-type situations were selected by a significant percentage of respondents who believed that they understood what PI is [Figure 1]. In a separate question, where the term “computer help desk” was explicitly used, 20% of all respondents, including 60% of surveyed CC attendings, agreed that providing those help desk services was a part of informatics. Another preconceived notion about informatics, that computer programming or code writing skills are necessary for its practice, was addressed in another question. Fifteen percent of all respondents felt that these skills were necessary for a practicing informaticist.

Interest in Pathology Informatics

Differences between the two institutions became more evident in the answers to questions within this area of focus. While just under 70% of MGH respondents found informatics “exciting,” fewer than 40% of CC respondents did. Interestingly, only 30% of all respondents who believed that computer help desk services are a part of informatics found informatics exciting.

However, 52% of CC attendings and 76% of CC trainees did express a desire to learn more about PI, as did 66% of their MGH counterparts [Figure 2]. Among respondents who found informatics exciting, 83% wanted to learn more about PI. The most pronounced difference in response rate between the institutions was observed in two questions designed to assess the impact of institutional culture on PI perceptions. About 92% of MGH attendings and 75% of MGH trainees believe that their department places a high value on PI

activities, in contrast to 61% of CC attendings and 36% of CC trainees. Respondent opinions regarding the value placed on PI education by their institution's residency program were in the same vein, with 24% and 14% of

CC attendings and trainees, respectively, feeling that PI education was valued highly. MGH respondents felt differently about PI education in their residency program, with 72% of attendings and 50% of trainees agreeing that PI education was highly valued [Figure 3]. About 57% and 66% of respondents who believed that their department and residency program valued PI also found PI to be exciting, while only 40% and 14% of those who did not feel that their department and residency program valued PI did so.

Table 2: List of activities from which respondents were asked to choose those related to informatics

Select all situations in which you believe informatics plays a role	Percentage of all respondents selecting situation
Reduction in redundant or inappropriate test ordering	92
Using technology to solve workflow problems	86
Guiding selection of test ordering	84
Resolving technology problems with display of presentations*	45
Specimen tracking in real-time	86
Installing new software programs on a desktop computer*	23
Reduction in manual key entry errors	63
Troubleshooting desktop computer issues (hardware as well as software)*	25
Reduction in patient/specimen identification errors	87
Appearance of pathology report in EHR	88
Learning how to use advanced functions in a word processing program*	20
Decreasing turnaround time	73
Research data-gathering	90
Digital pathology	89
HIPAA compliance	56

*Computer help desk/pure information technology-related situations (i.e., incorrect choices). EHR: Electronic health record, HIPAA: Health Insurance Portability and Accountability Act

Perceived Utility of Pathology Informatics

In this section, a relatively nuanced series of questions was developed to assess whether respondents found PI to be useful for both pathologists in general and on a personal level. Responses to three of the most representative questions within this area of focus are represented in Figure 4. Eighty percent of all respondents agreed that pathologists need to be familiar with and knowledgeable in informatics; only 4% disagreed. When asked to consider their personal careers, 76% of all respondents agreed that having informatics knowledge and skills would be an asset, and 56% felt that a lack of these skills would be detrimental. While 73% of respondents expressed an interest in including PI within their practice, with 72% acknowledging the importance of informatics to their careers as pathologists, only 65% actually planned to use PI. However, among those who found informatics exciting, 83% planned to incorporate PI into their careers.

As an effort to evaluate perceptions about whether or not informatics activities are exclusive to informatics-trained pathologists as opposed to being tools for all pathologists to use, the following two questions were included:

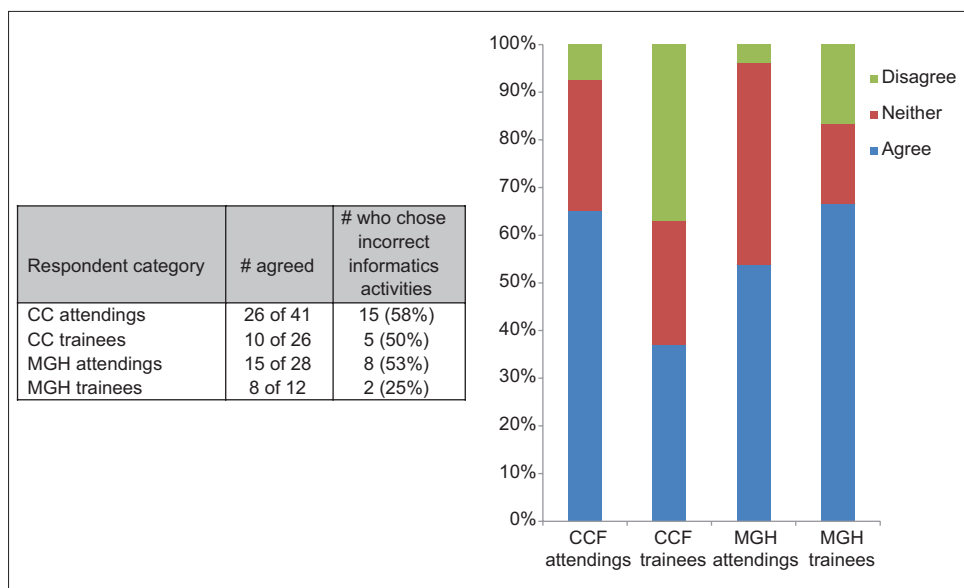


Figure 1: Responses to “I have a good understanding of what pathology informatics encompasses.” With the exception of Massachusetts General Hospital trainees, roughly half of these respondents selected incorrect pathology informatics activities, despite believing themselves to understand what pathology informatics entails

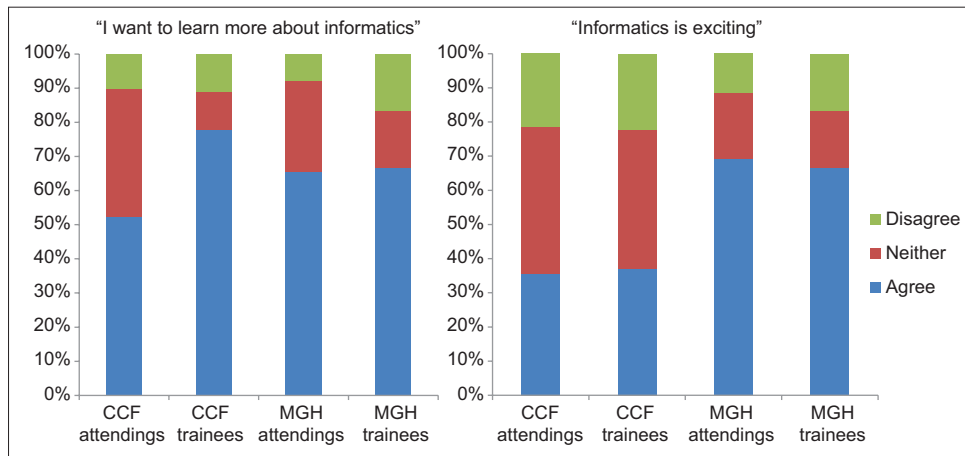


Figure 2: Considerably more respondents from Massachusetts General Hospital than Cleveland Clinic found informatics “exciting.” However, over half of respondents in all groups wanted to learn more about pathology informatics

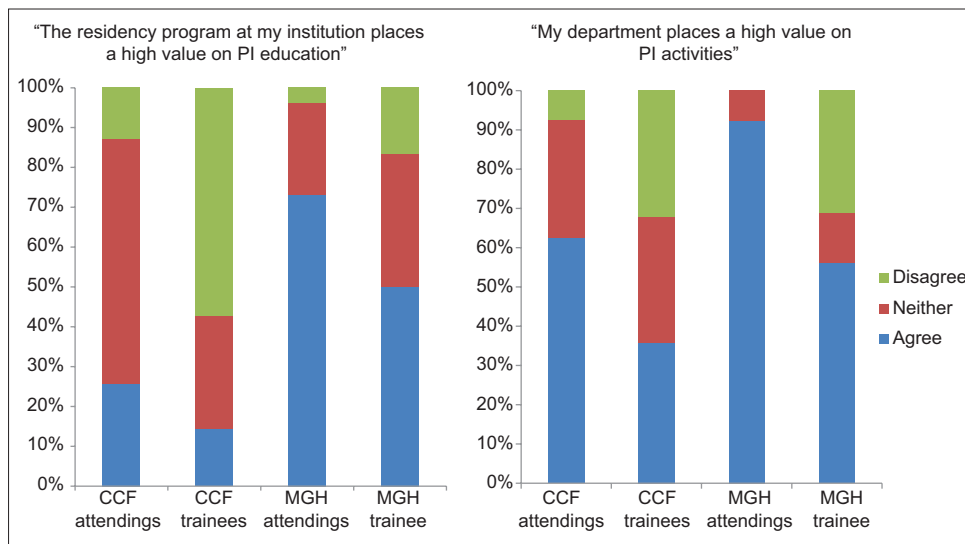


Figure 3: Fewer Cleveland Clinic respondents believe that pathology informatics is valued by their department and residency program than do the Massachusetts General Hospital respondents

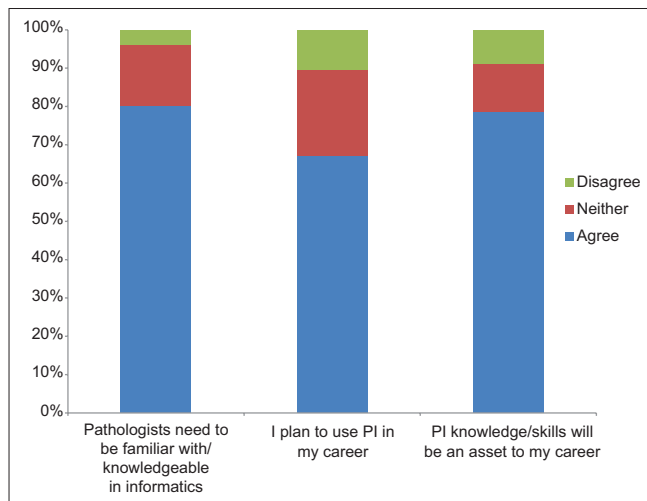


Figure 4: Nearly 80% of all respondents believe that pathology informatics knowledge and skills would be professionally useful and advantageous; however, fewer respondents actually plan to use pathology informatics

(1) “I regard PI as a set of techniques for all pathologists to use, analogous to immunohistochemistry” and (2) “I regard PI as a subspecialty to be practiced only by those with PI subspecialty training, analogous to medical kidney pathology.” The former question was designed to assess perceptions that informatics activities are exclusive or limited to only informatics-trained pathologists, i.e., whether pathologists would be as comfortable with taking on an informatics-related project to improve workflow processes as they would be with ordering an immunohistochemical stain in the workup of a surgical case. However, we acknowledge that the somewhat ambiguous language of this question does not necessarily direct the respondent to our interpretation, which we feel is highlighted by the near-equal, three-way split of the responses (35% agree, 37% disagree, 28% neither agree nor disagree). However, the more explicit, latter question provided more informative results. Twenty percent of all respondents believe that PI should be

practiced only by those with subspecialty (i.e., fellowship) training, while 61% feel that such training should not be a requisite for the practice of PI.

DISCUSSION

Pathology informaticists are aware of the potential that informatics applications have to enhance pathologists' ability to provide clinically actionable information by capitalizing on their unique expertise in laboratory and tissue diagnostics. The resulting improvements in patient care could further demonstrate the value of the pathologist's role. Potential opportunities for PI to enhance the value of pathology include the computational pathology initiative proposed by Louis *et al.*, as shown in Figure 5.^[1] Realizing these opportunities will require contributions from pathologists representing a range of subspecialties and practice types, and close collaboration between pathology informaticists and other pathologists. Such collaborations might require a foundational understanding of PI by many pathologists. Accurate insight into noninformatics pathologists' perceptions of PI could help guide and improve the development of educational efforts for them. By improving their understanding of what PI can and cannot do, greater

acceptance and adoption of PI by noninformatics pathologists could happen.

The goal of the study was to gain better understanding and insight into how PI is viewed by noninformatics-trained pathologists. As an initial project, this study focused on two large academic institutions and revealed several interesting findings. (1) Informatics is viewed positively by the majority of survey respondents. (2) Definitions of PI seem to vary greatly, even among those who believed they understood what PI is. Confusion between IT and PI, (i.e., perceived as synonymous disciplines) was evident. (3) A desire was observed at both attending and trainee levels to learn more about PI, suggesting that respondents are cognizant of their knowledge deficit in the subspecialty and are interested in remedying it. (4) While the majority of respondents believed that having some knowledge in PI would be professionally useful and advantageous, a somewhat smaller number planned to use it, which is perhaps reflective of the lack of a solid comprehension of what PI is, can do, and cannot do.

Overall, the survey showed that respondents were enthusiastic about informatics without necessarily understanding what it is. This combination can be problematic, as misperceptions of PI among pathologists unfamiliar with PI, especially if coupled with pathology informaticists' unawareness of the specific misperceptions, could lead to unrealistic expectations and frustrations on both sides. Left unchecked, misperceptions have the potential to further any marginalization of the PI subspecialty, distancing pathologists from the pathology informaticists who possess the unique skill sets needed for optimal application of informatics to enrich the value of laboratory operations. These consequences suggest a need for the PI community to actively work towards correcting misperceptions in the greater pathology community.

Thus, our study raises the question: How can pathology informaticists change these incorrect and undesired perceptions of a subspecialty that is so different from the traditional concept of the specialty it will benefit most directly? Education is one obvious approach, but historically, lasting success has been difficult to achieve or sustain. Difficulties with PI education due to inadequate resources have been well described in past literature.^[2,3,5] Well-intentioned efforts have ultimately not succeeded over time: The dedicated PI rotation at the University of Pittsburgh Medical Center, using pre- and post-tests^[6] is no longer in use (and it is unknown how much informatics knowledge from the rotation is retained by the resident later), a web portal that is no longer active,^[7] and a wiki site^[8] that generated much interest initially but ultimately did not capture the sizable user base necessary to keep the content in the wiki active.

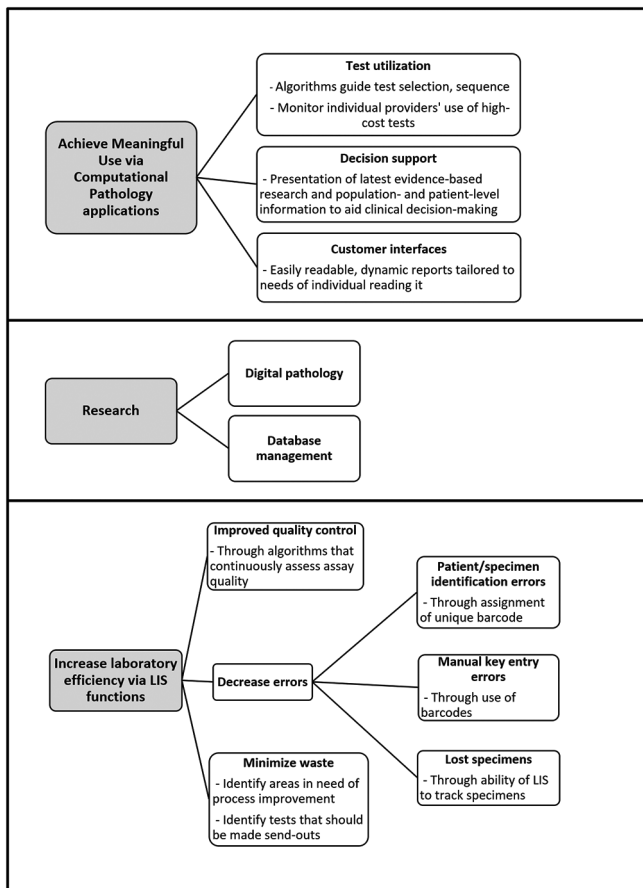


Figure 5: Potential opportunities for PI to enhance the value of pathology, adapted from Louis *et al.*^[1]

MGH has published a sizable number of articles on PI education, addressing topics such as a weekly didactics program sustained throughout the year,^[9] using business school-style case studies,^[10] and tailoring needs according to the interests of the individual, such as molecular pathology.^[11] However, these papers focus on education at the PI fellowship level, and not necessarily at the residency level. In contrast, the new Pathology Informatics Essentials for Residents (PIER) course, designed by PI leaders from many different institutions, is a promising new effort tailored for use at the resident level, without the need for local informatics-trained staff.^[12] As its introduction is fairly recent as of 2016, its degree of success will depend on the time and extent of its adoption by various residency programs.

In a recent symposium on decision support and pathology data integration, Baron *et al.* describe how and why many barriers to implementation of PI initiatives are “primarily personal, political, infrastructural, and administrative challenges rather than technological limitations.”^[13] One of our survey’s most striking findings – the difference between MGH and CC respondents in regards to the approach to PI taken in their departments and residency programs – lends further support to this assessment.

At MGH, as detailed by Garcia *et al.*,^[14] there is active and public endorsement of the importance of informatics for pathology from department leaders, and a strong, widely distributed, continuous presence of informatics in daily practice. Informatics-practicing faculty regularly sign out in an anatomic or clinical pathology subspecialty area. Many residents become involved in a PI-related project. Since 2008 – and since 2010 in collaboration with Brigham and Women’s Hospital (BWH) – MGH has offered PI fellowship training, and 10 of its 18 (as of 2014) fellows have been internal candidates from either MGH or BWH.^[14]

In contrast, many CC PI efforts focus on LISs, creating new interfaces (instrument to LIS and hospital to hospital) and the laboratory-related elements of the electronic health record system that serve a multi-site integrated health system that includes ten regional hospitals and 16 outpatient clinics, as well as a reference laboratory that serves clients in multiple states. PI at CC develops applications intended for department operations. CC does not currently offer a PI fellowship, and resident exposure to the discipline is minimal. There are two full-time, informatics-trained pathologists that oversee the PI center and perform service work in gastrointestinal surgical pathology and molecular genetic pathology. However, in the context of providing PI education, their ability to incorporate informatics into signout sessions with residents is limited by difficulties such as time and resident scheduling. At CC, informatics is not

as pervasive in day-to-day work compared to the MGH environment. For many CC pathologists and residents, most interactions with PI are in the form of calling the computer help desk line (which is organizationally located within CC’s center for PI and which handles requests for all issues related to desktop hardware and installation of desktop software, with requests for LIS support issues forwarded to LIS analysts), which likely contributes to the confusion and blurring between our strict working definition of informatics and IT. Although restructuring a pathology department around widespread informatics activities to the degree managed by MGH may not be feasible for all academic institutions, adopting some of the environmental practices described by Garcia *et al.*^[14] would be conducive toward creating an effective learning environment for PI.

CONCLUSIONS

As seen with other advances in the medical field, the evolution of the still-young and ever-expanding subspecialty of PI continues in academic medical centers. Having surveyed only two such institutions, we recognize the limits of this pilot study’s findings. Armed with the findings and insight from these initial findings, subsequent surveys involving additional locations and settings – academic centers with stronger and weaker emphasis on PI, and nonacademic centers (including community group practices) – could yield additional insight. The growing relationship of this crucial, foundational nature of PI to the future of the pathology specialty itself during the current changing regulatory and reimbursement environment underscores the need for stronger efforts in teaching PI to all pathologists, both at the staff and trainee level. Improved understanding and acceptance of PI throughout the pathology community could facilitate the communication and cooperation necessary to realize the type of informatics initiatives capable of advancing the importance of pathologists in the changing healthcare environment.

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Conflicts of Interest

There are no conflicts of interest.

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Supplementary material: Summary of responses to all Likert questions

Questions	Agree (%)	Disagree (%)	Neither (%)	Comments
Q1: Experience in computer programming or writing code is essential to being involved in PI				More MGH respondents believe that programming or writing code is necessary for pathology informaticians
CC attendings	14	69	17	CC culture focused on vendor supported software
MGH attendings	23	62	15	MGH encourages collaboration with vendors
CC trainees	14	46	39	Many MGH trainees involved in PI projects which fosters appreciation of programming/coding skills; they may perform "light" coding themselves
MGH trainees	50	25	25	
Q2: Providing computer help desk services for basic complaints not immediately related to lab operations is a part of informatics				
CC attendings	29	52	19	Some respondents in all groups believe that the help desk is a part of PI
MGH attendings	15	77	8	
CC trainees	11	71	18	At both CC and MGH, at least some help desk services are provided through the PI division
MGH trainees	8	84	8	
Q3: Pathology informaticians need to interact with other pathologists in their institution				
CC attendings	98	0	2	Near universal agreement on need for interaction between informaticians and other pathologists
MGH attendings	100	0	0	
CC trainees	96	0	4	Perhaps influenced by general spirit of consultation and interaction among pathologists at large academic centers with subspecialty signout
MGH trainees	100	0	0	
Q4: Informatics is exciting				
CC attendings	38	19	43	Nearly twice as many MGH respondents as CC respondents feel that informatics is exciting
MGH attendings	69	12	19	
CC trainees	36	21	43	Difference not surprising, given active effort of MGH pathology department to create a continuous and ubiquitous PI presence
MGH trainees	66	17	17	
Q5: My department values PI				
CC attendings	63	7	29	Majority of MGH respondents feel PI is valued by their department. CC trainees' opinions are split 3 ways
MGH attendings	92	0	8	Demonstrates effect of MGH commitment to PI
CC trainees	36	32	32	3-way split of CC trainee responses reflects lack of visibility of PI within department
MGH trainees	75	8	17	
Q6: My residency program places high value on PI education				
CC attendings	27	12	61	Majority of MGH respondents feel PI education is valued in their residency program. Majority of CC attendings seem unsure of PI education status in their program and majority of CC trainees feel it is not valued
MGH attendings	73	4	23	Many MGH trainees participate in PI projects which are plentiful and pertain to their subspecialty area of interest
CC trainees	14	57	29	
MGH trainees	50	17	33	
Q7: I want to learn more about PI				
CC attendings	54	10	37	All respondent groups express interest in learning more about PI
MGH attendings	65	8	27	
CC trainees	78	11	11	CC trainees especially interested, because/in spite of perceived limited exposure to PI education in residency program
MGH trainees	66	17	17	
Q8: Pathologists need to be familiar with and knowledgeable in informatics				
CC attendings	83	0	17	Majority of all respondents believe pathologists should have some level of understanding of PI
MGH attendings	81	4	15	
CC trainees	82	4	14	
MGH trainees	66	17	17	

Contd...

Supplementary material: Contd...

Questions	Agree (%)	Disagree (%)	Neither (%)	Comments
Q9: I plan to use PI in my career				
CC attendings	66	12	22	At least half of respondents in all groups plan to use PI in their personal career Difference between attendings and trainees may reflect age/stage in career Lower overall agreement rates here than Q8 and Q10 may indicate inability to envision application of PI to one's personal career, which may be due to lack of knowledge about PI, lack of departmental PI presence or simple lack of interest
MGH attendings	58	7	35	
CC trainees	71	11	18	
MGH trainees	75	8	17	
Q10: I understand the importance of PI in my career				
CC attendings	73	1	24	Overall more respondents agree that PI skills will be important for their personal careers than actually plan to use those skills in their careers (see Q9) CC trainees aware of importance of PI despite perceived low value placed on PI by department/program Again, lower agreement among MGH attendings may reflect stage in career
MGH attendings	58	11	31	
CC trainees	82	11	7	
MGH trainees	83	17	0	
Q11: I am not interested in using PI within my practice				
CC attendings	7	80	13	Majority of respondents in all groups are interested in using PI in their practice. More respondents in all groups except CC trainees express interest in using PI techniques than actually plan to do so (see Q9) CC trainees have least exposure to PI, which may make it difficult to envision using PI in their own practice
MGH attendings	12	65	23	
CC trainees	21	61	11	
MGH trainees	8	88	8	
Q12: PI knowledge and skills will be an asset to my career				
CC attendings	78	5	17	Similar response rates to Q8; majority of all respondents believe PI knowledge and skills would be an asset to their personal career Adds to Q8 by showing a positive regard of PI (i.e., not only do I need to understand PI as a pathologist but doing so will be a advantageous for me)
MGH attendings	77	8	15	
CC trainees	82	14	4	
MGH trainees	66	17	17	
Q13: A lack of PI knowledge and skills will not hurt my career				
CC attendings	17	56	27	While majority of all respondents believe PI knowledge and skills would be a professional asset (see Q12), a slightly smaller majority feel that a lack of PI knowledge and skills will have a negative effect on their career More CC trainees feel a lack would not hurt them, possibly due to their relatively minimal exposure to PI (see Q11)
MGH attendings	12	58	31	
CC trainees	29	54	18	
MGH trainees	8	59	33	
Q14: I regard PI as a set of techniques for all pathologists to use, analogous to IHC				
CC attendings	20	40	40	No clear feeling as to whether respondents believe that PI is a tool for all pathologists to use Question ambiguity: are we asking for a definition of PI or inquiring whether PI techniques should be accessible to all pathologists (we intended the latter)
MGH attendings	38	42	19	
CC trainees	57	25	18	
MGH trainees	25	42	33	

Contd...

Supplementary material: Contd...

Questions	Agree (%)	Disagree (%)	Neither (%)	Comments
Q15: I regard PI as a subspecialty to be practiced only by those with PI subspecialty training, analogous to medical kidney pathology				
CC attendings	24	61	15	Over half of respondents from all groups do not believe that fellowship training is necessary to be a pathology informatician Very little difference in response rate between the institution with a PI fellowship program (MGH) and the one without (CC)
MGH attendings	12	61	27	
CC trainees	21	64	14	
MGH trainees	25	58	17	

CC: Cleveland Clinic, MGH: Massachusetts General Hospital, PI: Pathology informatics, IHC: Immunohistochemistry