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A Comprehensive Analysis of Forensic Science Training in Forensic Pathology Fellowship Programs[†]

ABSTRACT: The purpose of this study is to assess the current nature and extent of forensic science training in the nation's 43 Accreditation Council for Graduate Medical Education (ACGME)-accredited forensic pathology fellowship programs. This manuscript describes the results of a survey of training program directors performed as a project for the College of American Pathologists (CAP) Forensic Identity Committee. The results show a considerable diversity in the forensic sciences training in forensic pathology programs, ranging from one to ten weeks, with an average of 4.1 weeks. However, almost one half of programs provide no training in at least one of the surveyed disciplines. Only 58.1% of responding programs meet the ACGME requirements for forensic science training, and a similar percentage (56.0%) currently provides the duration of forensic science training recommended by the National Association of Medical Examiners (NAME). The deficit in the NAME training recommendations, surprisingly, was strictly in the field of toxicology.

KEYWORDS: forensic science, forensic pathology, fellowship, crime laboratory

Forensic science is a broad term encompassing forensic pathology as well as many other disciplines. The non-pathology forensic science disciplines are having an increasingly higher impact on criminal investigations to include medicolegal death investigations. Advances in DNA identification technology alone have revolutionized the daily practice of forensic pathologists. For example, it is now commonplace for forensic pathologists to spot blood standard cards from all bodies for possible future DNA analysis. These other specialized fields in the forensic sciences, such as toxicology, blood spatter analysis, and trace evidence, can and should aid the forensic pathologist in finalizing the cause of death in a wide variety of cases. Furthermore, a number of medical examiner's/coroner's offices are becoming integrated with the crime laboratory, either geographically or with respect to their daily working relationships with one another. In order for forensic pathologists-in-training to appreciate the complexities inherent in each field, we believe that solid fundamental education in these specialized areas will be increasingly important for the future of forensic pathology.

The purpose of the current study is to assess the extent to which forensic pathology fellows around the country obtain specialized forensic science training in the non-pathology disciplines. A three-page survey with questions regarding the nature and quantity of forensic science training was sent to the directors of all 43 active,

ACGME-accredited forensic pathology fellowship programs. Many other subspecialties within pathology (1–6) have published surveys of the types of training that residents or fellows receive. However, to date none has been published concerning the training of forensic pathology fellows. The results of this study should prove valuable for assessing the current state of training in the various specialized areas of forensic sciences that are increasingly being utilized in the crime lab. The information gleaned from this study may also aid members of the National Association of Medical Examiners (NAME) Subcommittee on Forensic Pathology Fellowship Training in subsequent revisions to their recent training program guideline recommendations (7).

Methods

A survey to analyze non-pathology forensic science training in forensic pathology fellowships was constructed in three parts. The first part assessed the demographics of the forensic pathology fellowship program. Information requested included the number of fellows for which the program is accredited, the number of positions usually filled, the number of pathologists the office employs, the number of autopsies the office performs, and whether the office is affiliated with an academic university, medical school, or teaching hospital. Additional information, such as whether the office operates under a medical examiner or coroner system, and whether the office is accredited by the National Association of Medical Examiners, was obtained elsewhere (7,8).

The second part of the survey was aimed at gaining an understanding of the extent to which the medical examiner's/coroner's offices are integrated with the crime lab. Questions were directed at eliciting whether any components of the crime lab are either under the control of the medical examiner's/coroner's office or are located in the same facility. The specific areas of inquiry were DNA-based identification, toxicology, arson analysis, firearms and

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toolmarks analysis, blood spatter analysis, and trace evidence and fingerprint examinations. We chose not to ask about disciplines not traditionally considered part of the crime lab, such as anthropology, entomology, and forensic odontology.

The third part of the survey addressed training received by fellows in various specialized forensic disciplines within the crime lab. The questions were directed primarily at ascertaining the location and duration of training in each of the listed areas of forensic science. The survey also asked whether fellows were sent to courses, seminars, or meetings, and whether fellows had published papers or given presentations dealing exclusively with the specialized areas of forensic investigation outlined above (i.e., those not dealing primarily with forensic pathology).

The survey was sent to the program directors of all 43 currently active ACGME-accredited forensic pathology fellowship training programs, located in 25 states, the District of Columbia, and Puerto Rico.

Results

Of the 43 surveys sent out, 31 of them (72.1%), representing 22 states (of 25 states with fellowship programs) and the District of Columbia, were returned. The completed surveys account for 59 of the 84 fellowship positions available annually, corresponding to 70.2% of all fellowship positions. Information about non-responding programs was obtained from publicly available sources (7,8). The subsets of responding and non-responding programs exhibited no statistically significant differences in the number of fellowship positions, geographic distribution, coroner versus medical examiner jurisdictional type, and NAME accreditation status (Table 1). Therefore, we obtained a representative sample of forensic pathology fellowship programs with respect to demographic characteristics.

Demographics

Of the fellowship positions per program available annually in the responding programs (average 1.9); an average of 1.7 positions were reported filled each year. Most of the medical examiner's/coroner's offices employ five fewer full-time pathologists (64.5%), with a median of four, not including fellows (Fig. 1a): 22.5% employ between six and ten, two programs (6.5%) employ between eleven and twenty, and another two programs employ greater than 20 pathologists. A median of 1200 autopsies is performed annually. Eleven programs (35.5%) perform between 501 and 1000 autopsies, while an equal number perform between 1001 and 2000 cases. Three pro-

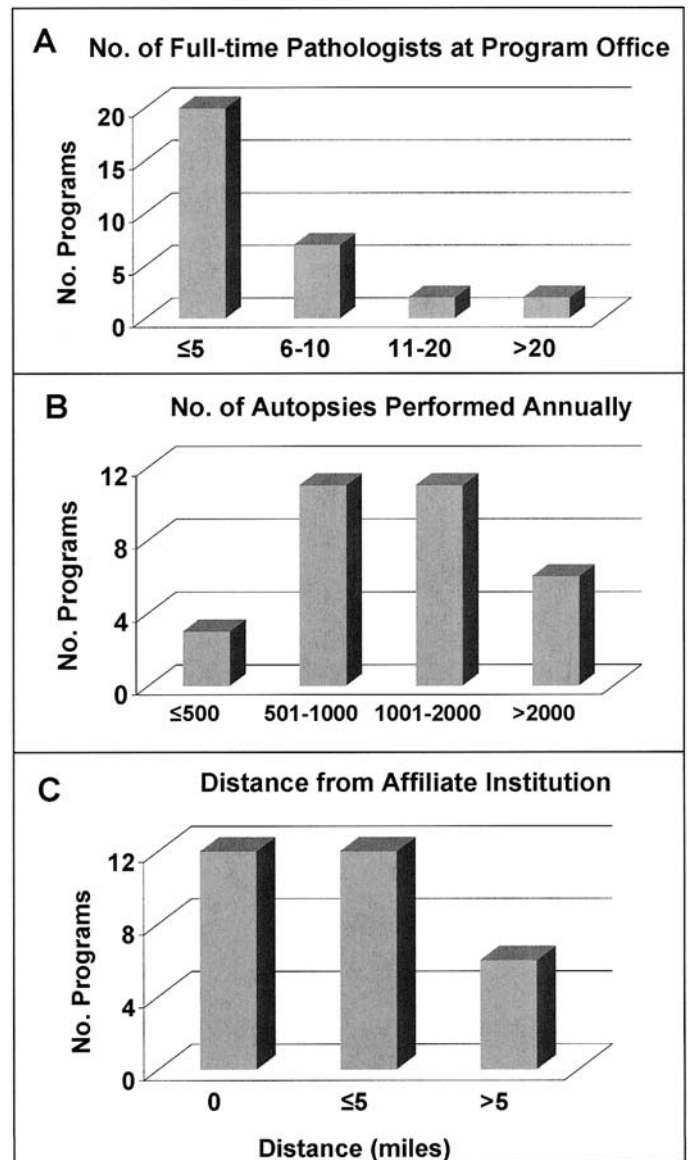


FIG. 1—Demographics of the medical examiner's/coroner's offices associated with the forensic pathology fellowship program: (a) the number of full-time pathologists employed by the program office, median = 4 pathologists; (b) the number of autopsy cases performed annually, median = 1200 cases; (c) the distance between the program office and the affiliated university, medical school, or teaching hospital, median = 1 mile.

TABLE 1—Characteristics of responding versus non-responding programs.

Characteristic	All Programs	Survey Responders	Non-Responders	P-value*
No. of programs	43	31 (72.1%)	12 (27.9%)	...
Fellowship positions	84	59 (70.2%)	25 (29.8%)	...
Avg. no. positions/program	2.0	1.9	2.1	0.302
Geographic location [†]				
East	33 (76.7%)	23 (74.2%)	10 (83.3%)	0.698
West	10 (23.3%)	8 (25.8%)	2 (16.7%)	
System				
Medical examiner	35 (81.4%)	26 (83.9%)	9 (75.0%)	0.665
Coroner	8 (18.6%)	5 (16.1%)	3 (25.0%)	
NAME accredited office	19 (44.3%)	15 (48.4%)	4 (33.3%)	0.50

*P-value for two-sample Wilcoxin rank-sum (Mann-Whitney) test (average number of positions/program) or Fisher exact test (all other comparisons); none was significant at $P < 0.05$.

[†]Geographic location refers to East or West of the Mississippi River.

grams (9.7%) perform 500 autopsies or fewer, and 6 programs (19.4%) perform greater than 2000 autopsies annually (Fig. 1*b*). All programs are affiliated with a university, medical school, and/or teaching hospital, located a median distance of one mile away from the medical examiner’s/coroner’s office. Thirteen (41.9%) are located on the campus, and twelve (38.7%) are located separate from the campus but still within a five-mile radius (Fig. 1*c*). The remaining six programs (19.4%) are located greater than five miles away.

Association with Crime Laboratories

When asked, “In general, how closely and in what areas does your office work with your local crime lab?” 30 of the 31 respondents answered. Four programs indicated that the entire crime lab is under the supervision of the medical examiner’s/coroner’s office. Eleven programs responded that they had a “close” working relationship with the crime lab, five stated that they interacted primarily to turn over evidence obtained from the body, four indicated that they consulted with the crime lab in unusual cases, four stated that technologists from the crime lab attended the autopsy, two stated that they did not have a close relationship with the crime lab, and one indicated that most consulting with the crime lab was by telephone due to the large distance between them.

For each of the crime lab disciplines included in the study, the programs were asked: (1) who performs each of the types of casework, (2) where that facility is located, and (3) how far away from the medical examiner’s/coroner’s office that laboratory is located. The results are shown in Table 2. Not surprisingly, most of these specialized analyses are performed by a governmental or police laboratory. However, some degree of integration was reported. The majority of programs (67.7%) reported that toxicology casework is performed at the medical examiner’s/coroner’s office. Some of the other surveyed disciplines are also performed at the medical examiner’s/coroner’s offices, ranging from 12.9% for fingerprint examinations and arson analysis to 29.0% for DNA-based identification. The remainder of these analyses was performed by governmental laboratories (ranging from 16.1% for toxicology to 54.8% for both arson and trace evidence analysis), police laboratories (ranging from 3.2% for toxicology to 41.9% for fingerprint examinations) or private laboratories (3.2% for DNA-based identification and 12.9% for toxicology). Although the maximum distances are quite large (the highest cited was 400 miles), the minimum and median distances indicate that, for the majority of programs, all of the surveyed branches of forensic science are either performed in a laboratory located in the same building as the training program office or within five miles.

Forensic Science Training

Twenty-eight program directors responded to the question asking whether fellows are sent to courses, seminars, or meetings. Twenty-five percent of respondents stated that fellows attend the Armed Forces Institute of Pathology (AFIP) forensic pathology course; 46.4%, a forensic anthropology course; 64.3%, the American Academy of Forensic Sciences Annual Meeting; 42.9%, the annual meeting of NAME; and 14.3%, a death investigation course. One program also listed courses in forensic entomology, evidence collection, and bite mark analysis. All responding programs send their forensic pathology fellows to at least one meeting.

The total time spent training in the crime lab varied from one to ten weeks, with an average of 4.1 weeks (Fig. 2*a*). Training times for toxicology ranged from two days to six weeks, with an average of two weeks (Fig. 2*b*). Not all of the returned surveys provided itemized training times in each of the specific areas as requested; however, most (25 of 31 programs) answered for toxicology and all 31 indicated the total training time. Therefore, the time spent in toxicology was subtracted from the total training time in order to estimate the overall time spent in all of the areas of the crime lab other than toxicology (this is one of the categories used by NAME for forensic science training recommendations). This time ranged from one to eight weeks, with an average of 2.6 weeks (Fig. 2*c*).

Focusing on the programs which did itemize training times in specific areas of the crime lab, it is evident that there is wide variation in the amount of training that forensic pathology fellows receive; individual histograms are shown in Fig. 3. A summary of minimum, maximum, and average training times is listed in Table 3. For each of the surveyed forensic science disciplines, average training times ranged from 1 to 3.3 days. Some programs cited no training at all in arson analysis (25.0%), blood spatter analysis (30.0%), fingerprint examination (31.8%), and, remarkably, DNA-based identification (one program, corresponding to 5.0%). One respondent added that fellows at that program receive one day each in documents and photography (areas not specifically covered by the survey).

Furthermore, by comparing the responses from Part II of the survey (listing where casework in each discipline is performed) to those from Part III (listing how and where fellows receive training in that area of the crime lab), it is evident that some of the training is not taking place at the laboratory that performs the casework in that jurisdiction, ranging from 6.7% of programs for toxicology to 28.6% of programs for blood spatter analysis (Table 3). Respondents from these programs indicated that training in these fields was provided at a different laboratory, at their own medical examiner’s/coroner’s office (as case-based learning from autopsy

TABLE 2—Characteristics of laboratories performing particular area of forensic science.

Discipline	Type of Laboratory Performing Service (% of responding programs)				Distance* (miles)		
	ME/Coroner Office	Government	Police	Private	Min	Max	Median
DNA	29.0	41.9	25.8	3.2	0	107	1.0
Toxicology	67.7	16.1	3.2	12.9	0	82	0
Arson	12.9	54.8	32.3	0	0	107	5.0
Blood spatter	24.0	44.0	32.0	0	0	100	1.9
Fingerprints	12.9	45.2	41.9	0	0	400	2.0
Firearms/toolmarks	16.1	51.6	32.3	0	0	107	1.9
Trace evidence	19.4	54.8	25.8	0	0	107	1.7

*Distance between medical examiner’s/coroner’s office and the laboratory where testing takes place.

For each discipline, the highest percentage (i.e., representing the most common type of laboratory performing the analyses) is denoted in bold type.

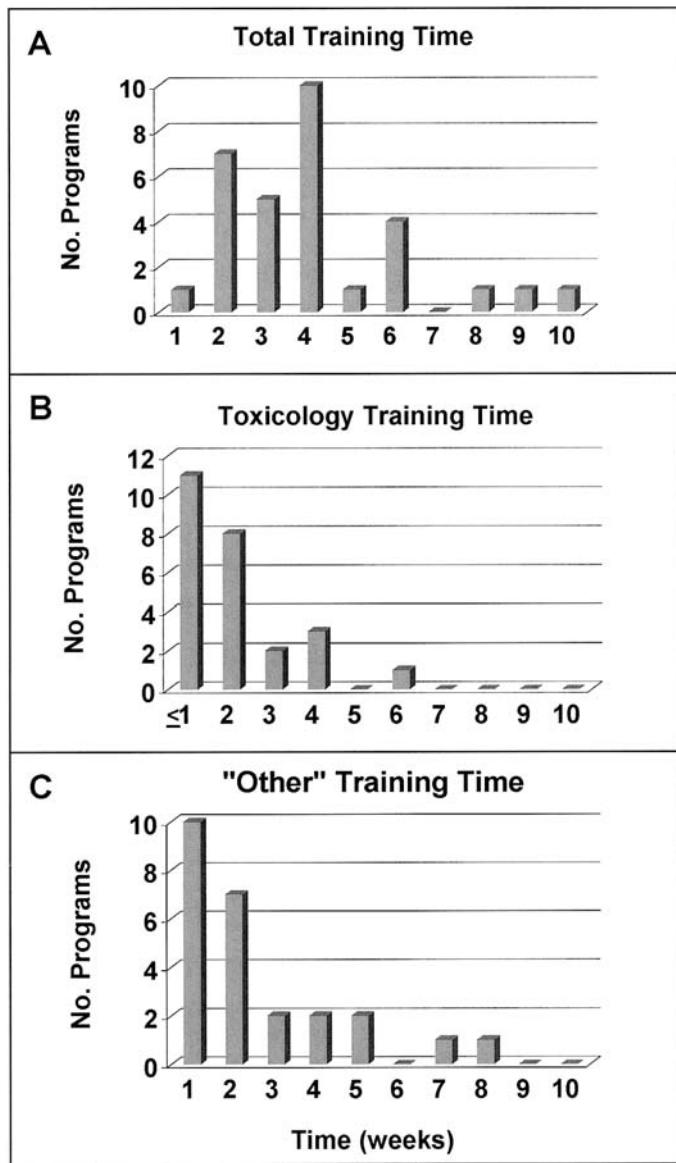


FIG. 2—Histograms of (a) total training time in the non-pathology forensic sciences, (b) training time in toxicology, and (c) "other" (than toxicology) training time. These values were calculated by subtracting the toxicology training time from the total training time. All training times are represented in weeks.

cases, for example) or that fellows received training at an outside course, seminar, or meeting.

No correlations were observed between duration of training in the forensic sciences and size of the office (including number of cases, number of fellows, and number of full-time pathologists), whether the office is a medical examiner or coroner system, whether the office is accredited by NAME, or the distances between the office and the laboratories performing the forensic casework.

The final question of the survey was "How many papers or presentations on research into the criminalistic aspects of forensic investigation were written/given by forensic pathology fellows in your program last year (2000)?" One program cited two (the topics were unspecified), and two cited one or more papers in toxicology. The remainder of programs replied "zero."

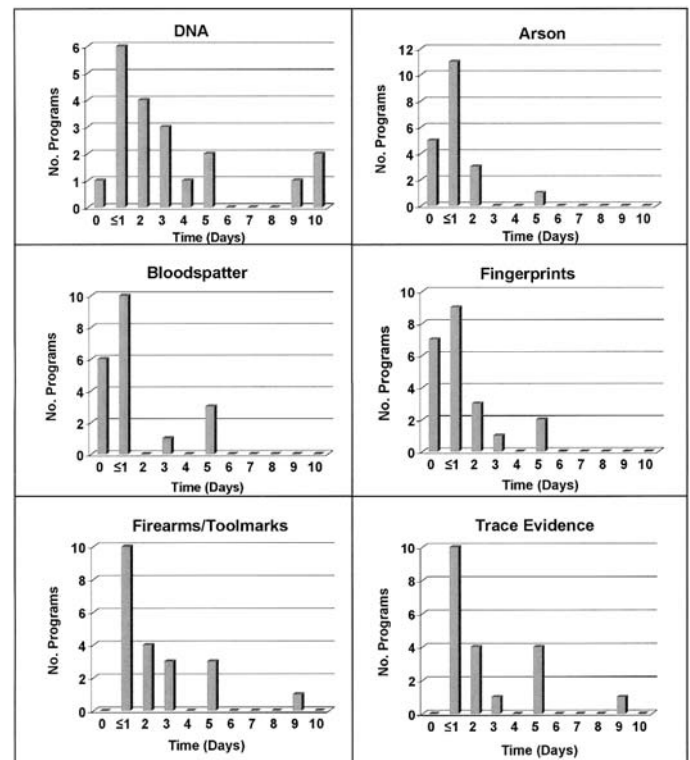


FIG. 3—Histograms of the training times (in days) for each of the surveyed disciplines.

TABLE 3—Lengths of training in various disciplines of forensic science.

Discipline	Training Time*			No. Responding [†]	Different Location [‡]
	Min	Max	Average		
Toxicology	2 d	6 w	2.0 w	25	6.7%
Others [§]	1 w	8 w	2.6 w
Arson	0	5 d	1 d	20	20.0%
Blood spatter	0	5 d	1.3 d	20	28.6%
Fingerprints	0	5 d	1.2 d	22	13.6%
Firearms/toolmarks	0.5 d	9 d	2.4 d	21	13.3%
DNA	0 d	10 d	3.3 d	20	24.1%
Trace evidence	0.3 d	9 d	2.4 d	20	10.0%
ALL	1 w	10 w	4.1 w	31	...

*d = days; w = weeks.

[†]Refers to the number of respondents (of the 31 returned surveys) who itemized training times in each specific area.

[‡]Refers to training of fellows taking place at a location other than where the forensic discipline is normally performed.

[§]Since not all programs itemized training times, the sum of training in areas other than toxicology was derived by subtracting the toxicology training time from the overall training time (ALL) in the crime lab.

Some respondents wrote additional unsolicited comments on the survey form; others initiated conversations with the authors at the 54th Annual Meeting of the American Academy of Forensic Sciences, where this work was presented. Some of these comments and discussions indicated that the opportunity for the forensic science training is often pre-empted by autopsy casework or otherwise, or that such training is not needed if their graduates would not be engaged in such practices.

Discussion

The results of this survey reveal that the extent of training in a variety of forensic science disciplines is widely variable among different training programs and is generally deficient; the total time spent in training in the surveyed areas ranged from one to ten weeks.

The current ACGME/Resident Review Committee (RRC) requirements for training are “approximately 4 to 8 weeks devoted exclusively to laboratory experience in toxicology, physical anthropology, and components of the crime laboratory such as firearms, serology and trace evidence” (8). According to the data collected from this survey (in response to the question, “How long (total) do forensic pathology fellows spend rotating through the crime lab?”), 41.9% of programs do not meet this minimum requirement of four weeks. The wording of the ACGME does use the term “approximately” when referring to the amount of time required, presumably in order to allow some flexibility for training programs. Although the ACGME requirement lists physical anthropology, a discipline about which we did not inquire, as being eligible to contribute to the training time requirement, it also designates that the training be exclusively by laboratory experience. While almost half of programs cited sending their fellows to didactic courses in physical anthropology in response to the question, “Are your fellows sent to any courses, seminars, or meetings?” this would not qualify as specific laboratory training mandated by the ACGME guidelines.

The NAME Subcommittee on Forensic Pathology Fellowship Training has recently finalized its own set of recommendations for what the ACGME should require of forensic pathology fellowship programs (7). Among these recommendations are suggested guidelines for non-pathology forensic science training. The NAME recommends 80 h of toxicology training and 40 h in aggregate for the other disciplines. Assuming 40 h in a workweek, 44.0% of responding programs do not meet the NAME recommendation for toxicology training. This result was somewhat surprising, given that 67.7% of medical examiner’s/coroner’s offices reported having an integrated laboratory for toxicology, more than any of the other surveyed forensic disciplines. Toxicology is probably the most important of the non-pathology forensic sciences for the forensic pathologist. Toxicology is performed in the majority of autopsy cases; the results can often be the deciding factor that dictates how the pathologist signs out the cause and manner of death. This being the case, it seems that half of programs not meeting the NAME recommendations for toxicology represents a substantial deficit in training. In addition to practical teaching in the toxicology laboratory, training could also be supplemented, for example, by weekly case-review of toxicology analyses from the medical examiner’s/coroner’s office in order to integrate toxicology results with their interpretation in the context of the autopsy.

In contrast, all responding programs in this survey either meet or exceed the NAME recommendation for all of the surveyed disciplines of forensic science other than toxicology (denoted as “other” in Fig. 2c and Table 3). However, almost half (48.8%) of survey respondents who itemized training times cited no training in at least

one of the surveyed areas. Additionally, between 6.7 and 28.6% of responding programs (depending on the discipline) do not train their fellows in the various areas of forensic sciences in the crime laboratories that normally perform the casework in the area served by the medical examiner’s/coroners office. Some cite courses, seminars, meetings, or follow-up of individual autopsy cases as the primary mechanism of training. Unlike toxicology, training in these disciplines would be difficult to obtain on-the-job. Supplemental training in both toxicology as well as the “other” disciplines, by means of conferences, individual case follow-up, or independent study throughout the year of fellowship training is also advocated (and expected) by the NAME recommendations but is intended to extend above and beyond the recommended amounts of formalized training in the laboratory. While we were not able to identify any predictors of training times from the information we collected, it is possible that the number of autopsies performed by fellows (for which there are also limits defined by both the ACGME and NAME) in some programs precluded much time spent training in the other forensic sciences. While we asked about the autopsy caseload for the entire office, we did not inquire specifically about the number of cases each fellow completes. There was, however, no correlation between training times and the calculated ratios of the number of cases to the number of fellows or to the number of full-time pathologists.

The authors believe that 72.1% is an excellent response rate for a survey. However, while the demographic characteristics of the responding and non-responding programs are not significantly different, we cannot rule out a potential responder bias. Specifically, we cannot exclude the possibility that programs with more forensic science training were more likely to respond to the survey while those with less training might have been less likely to respond. If this were the case, then our data overestimate the amount of forensic science training times in forensic pathology fellowship programs, which would make the compliance with training requirements/recommendations less than what we report. Any responder bias present, however, will be somewhat attenuated by the high response rate to the survey.

From the unsolicited comments received as well as the discussions occurring during presentation of this work, it became apparent that some program directors felt that the opportunity for the forensic science training is often pre-empted by autopsy casework such that the non-pathology forensic science training is actually less than the survey results suggest. Some program directors felt that such training is not needed if their graduates would not be engaged in such practices. The authors of this report strongly disagree and believe instead that exposure to these other forensic disciplines is critically important.

First, even though forensic pathologists will likely never actually perform most of these analyses themselves, we believe that they must be able to effectively communicate with other forensic scientists. Medicolegal death investigation is a multifaceted approach combining the forensic pathologist determining the cause and manner of death and the crime lab obtaining as much information as possible from the evidence, which together, will assist law enforcement in their investigation. No one discipline can work effectively without communicating with the others. Forensic pathologists must at least know the language of the other forensic scientists (and vice versa) in order to work effectively together. A forensic pathologist needs to understand the meanings of the terms “friction ridge” and “short tandem repeat” if he/she is to effectively interact with fingerprint or DNA-based identification experts, respectively. Ideally, these interactions should consist of more than simply the turning over of evidence to another department.

Second, forensic pathologists must have a working knowledge of both the capabilities as well as the limitations of the non-pathology forensic sciences. How can a forensic pathologist know what type of specimens or evidence is important if he/she does not know what the toxicologist or trace evidence expert is capable of doing with that material? The forensic pathologist does not need to know how to repair or operate a gas chromatograph/mass spectrometer, but he/she does need to be able to understand the difference between a drug screen and a confirmatory test, and have a concept of how each is performed. Similarly, the forensic pathologist must be aware of what is not possible in the crime lab. Pathologists must have a firm grasp on how specimens or evidence is handled once it leaves the medical examiner's/coroner's office; they must know how the various types of testing are performed in order to properly collect and handle the material. The best way to obtain this sort of realistic understanding of how the crime lab works is to have some actual hands-on, or at least eyes-on, experience-based training at the bench. The survey results would suggest that this is at least geographically feasible; although some crime labs are located far away, the majority of the laboratories performing the casework are located within five miles of the medical examiner's/coroner's office. For legal reasons, the trainee may not be able to perform actual analyses, but at least actually seeing a technique performed solidifies the principles behind it.

Third, training in the non-pathology forensic sciences would also expose the forensic pathology fellow to the legal and political issues common to the forensic sciences. Forensic pathology has, in general, not faced the same magnitude of legal scrutiny experienced by the other forensic sciences, but it may evolve in that direction. Forensic pathologists and non-pathology forensic scientists have also worked together in the political arena, for example, lobbying for the passage and appropriation of the National Forensic Sciences Improvement Act (9), which will provide financial backing for both groups of forensic scientists. Moreover, exposure to the broader law enforcement community is bound to be of import to the trainee.

In summary, 41.9% of programs appear to fail to provide the amount of training required by ACGME, and a similar percentage (44.0%) do not meet the recommendation for toxicology training suggested by NAME. The NAME recommendations do not itemize which fields other than toxicology should be included; however, the training time of 40 h (or, one week full-time) in these other fields of forensic sciences appears to be met by all of the responding programs. It is our opinion that the practice of forensic pathology will be increasingly more influenced by the non-pathology forensic sciences, and a working knowledge of these various fields will be necessary for optimal performance in the

field of forensic pathology. The results of this survey should be useful for formulating future training objectives as forensic pathology becomes progressively more integrated with other forensic science disciplines.

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