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Critical Human Resource Issues: Scientists Under Pressure

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Introduction

Forensic science laboratories have experienced increased demand for more, better, quicker, and cheaper forensic science, integrated databases, and emergent technology (Mennell and Shaw 2006). In the United States, increased demand has resulted in a national case backlog, leaving many public laboratories with the resources to analyze only the most serious cases (Fisher 2003; Perlman 2004). Because of the case backlog, only one-third of the cases submitted to crime laboratories are actually analyzed (Peterson and Hickman 2005).

As part of the organizational structure of police departments, public laboratories provide services without charge to their constituencies. Small police departments often cannot budget the funding to increase staffing or build new facilities. The demand for timely analyses of DNA cases can overwhelm public agencies. As resource constraints limit services, cases are outsourced to private laboratories.

Interventions to improve the situation are hampered in that documentation of staffing issues is limited. Human resources in forensic laboratories can be viewed as assets as opposed to variable costs. A resource-based view proposes that job-related behaviors of employees maximize the overall performance of the organization. The intellectual capital of the laboratory is valuable, rare, inimitable, and nonsubstitutable (Dale and Becker 2005; Wright et al. 1994). Intellectual capital is valuable in that the knowledge, skills, and abilities that forensic employees possess vary greatly within and across laboratories. Employees that work at a higher level of proficiency are more valuable to the laboratory. Laboratories that are able to select, develop, motivate, and retain skilled employees will outperform laboratories that are not. Intellectual capital is rare in that forensic science skills are increasingly in short supply, and there is wide evidence of a growing shortage of needed technical workers (Peterson and Hickman 2005). Intellectual capital is inimitable in that laboratory goals and environmental circumstances must be in alignment; human resource practices and support systems must be designed to retain human resources. Intellectual capital is nonsubstitutable in that laboratories that use management practices to develop and motivate people have a source of sustained competitive advantage over laboratories that do not (Dale and Becker

2005).

The purpose of the present study was to document basic personnel information in laboratories, such as total number of staff, educational degrees obtained, hours worked, pay level, overtime, and number of cases processed. We identified 17 “pressure to perform” variables that we propose are related to resource allocation and time available to forensic scientists to complete casework. We sought to examine more closely the relationship between staffing and performance in public forensic laboratories and to address the following important questions:

- What is the current state of forensic science laboratories in an environment of staff shortages and increased demand for services?
- What impact do these environmental pressures have on laboratory productivity and performance?
- Are laboratories meeting the increased demand for services by outsourcing cases to private laboratories?

Survey of Forensic Science Laboratory Directors

The directors of 250 public forensic science laboratories in the United States were identified as expert informants for staffing and performance issues. A Web-based survey was developed. Web surveys have a high degree of acceptability from respondents, are self-administered, and have a quick turnaround time and low cost (Dillman 2000; Thompson et al. 2003). The use of list-based samples of targeted populations is recommended (Couper 2000). The U.S. Fish and Wildlife Service maintains a list of the American Society of Crime Laboratory Directors (ASCLD). We obtained permission from the current ASCLD director to request participation from directors through an e-mail solicitation. A reminder was sent two weeks after the initial request. Follow-up phone interviews were conducted with directors to clarify specific items.

The survey consisted of 46 items grouped into six sections: demographics, caseload, recruitment, turnover, retention, and performance issues. The demographic section consisted of a description of the forensic science laboratory system and operating procedures, including “How many forensic scientists (testifying personnel) work in the laboratory?” and “What is the population of your primary geographical service area?” Present capacity consisted of questions about caseload, such as “How many criminal cases are handled per forensic scientist per month? DNA convicted offenders? DNA casework?” The extent of outsourcing to private laboratories was addressed by such items as “How many cases do you send out per year (due to backlog) for private laboratory analyses in the following disciplines: Casework PCR DNA? Casework Mitochondrial DNA?” Employee performance issues assessed the extent to which respondents agreed with such items as “Forensic scientists are pressured to complete cases in a timely manner” and “Forensic scientists have enough time to perform the job well.” Additional questions about caseload included “How old (in months) is the oldest case in your laboratory?” and “Do you have sufficient scientists to handle the [number] of cases?”

Items consisted of a combination of open-ended response items, yes/no, and Likert-type items. Likert items measured, on a 5-point scale, the extent of agreement or disagreement. We used the convention that the lower end of the scale represented disagreement with the statement; that is, 1 = strongly disagree, and 5 = strongly agree. The Web survey format included radio buttons, short-entry boxes, long-entry boxes, and drop-down boxes. The survey was initially piloted with two laboratory directors who provided content and format improvements.

Instructions for accessing the Web survey were sent in an e-mail announcement memo. This memo addressed the survey's goals, the anonymity of responses, and the importance of responding, as suggested in Zatz (2000). Directors were assured of the confidentiality of their individual responses; participants were given the option of including their address and phone number for future follow-up.

The survey was created using common gateway interface (CGI) scripts on an application form. The data were collected using a secure server that encrypted survey answers into a single file at the University at Albany and were downloaded weekly for a period of eight weeks. The data were transferred to an Excel spreadsheet and analyzed using SPSS (Statistical Packages for the Social Sciences).

Description of Results

Federal, state, and local forensic laboratories of all sizes participated. The response rate for mailed surveys is generally 10 to 50 percent (Couper 2000). We received 55 usable responses, representing a 22 percent return rate. Table 1 provides a description of summary variables. Note that population served ranged from 59,000 to 22 million. Overtime hours per week were 15 hours maximum, with an average of 2.76 hours. The maximum number of off-bench hours per week was 20, with an average of 10.13 hours. Pay for nonsupervisory scientists ranged from $28,800 to $116,000, with an average of $59,087.46. The oldest case ranged from 0 to 480 months, with an average of 28.22 months. On average, 9 additional forensic scientists were needed, with a maximum of 70. Additional descriptive data are provided in Table 1.

Table 1: Description of Laboratories Participating in the Survey

	Number	Minimum	Maximum	Mean
Population*	53	59,000	22,000,000	2,461,329
Number of Forensic Scientists	55	2	280	33.57
Number of Bachelor's Degrees	55	2	250	24.38
Number of Master's Degrees	55	0	35	5.55
Number of Doctoral Degrees	55	0	20	1.62
Number of Laboratories (in Multilaboratory Systems)	22	2	12	5.14
Hours Worked per Week	53	25	43	39.08
Overtime Hours per Week	51	0	15	2.76
Off-Bench Hours per Week	50	0	20	10.13
Top Pay Level Nonsupervisory Role	50	$28,800	$116,000	59,087.46
Age of Oldest Case in Months	48	0	480	28.22
Number of Additional Scientists Needed	41	1	70	9.12

*Excludes one laboratory that serves the military and one national laboratory that serves 180 million

Table 2 provides information about the present capacity of the laboratories; the number of cases that are completed per scientist per month in laboratories is reported. (Note that the mean plus one standard deviation [SD] represents 68 percent of the population; mean plus two SD represents 95 percent of the population). On average, laboratories handled 91.32 toxicology cases per scientist per month, 52.78 DNA convicted offender cases, 86.73 narcotics cases, 29.99 latent print cases, 10.60 DNA cases, 17.52 firearms cases, 8.87 trace evidence cases, 5.77 questioned document cases, and 5.95 other cases. The total number of cases completed per month across all laboratories in the sample was 10,024.

Table 2: Present Capacity: The Number of Cases Completed per Scientist per Month

Types of Cases	Number	Minimum	Maximum	Mean	SD	Total (All Labs)
Toxicology	32	0	1,370	91.32	251.36	2,831
DNA Convicted Offender	18	0	540	52.78	129.92	950
Narcotics	43	0	250	86.73	61.43	3,556
Latent Print	34	0	135	29.99	39.19	960
DNA Casework	39	0	92	10.60	15.18	403
Firearms	41	0	80	17.52	17.93	701
Trace Evidence	39	0	38	8.87	7.46	337
Other	19	0	34	5.95	8.31	113
Questioned Document	30	0	25	5.77	7.05	173
Total Cases						10,024

Table 3 provides additional information about capacity, reporting the number of cases outsourced to private laboratories per year. On average, public laboratories outsourced 3186.53 DNA convicted offender cases per year, 370.77 PCR DNA cases, 88.44 toxicology cases, 4.05 mitochondrial DNA cases, and 1.95 questioned document cases. Less than 1 case each involving hair identification, ballistics, fiber, and controlled substances was outsourced per year. The total number of cases sent to private laboratories per year across all laboratories in the sample was 142,449.

Table 3: Capacity Needed: Cases Currently Outsourced to Private Laboratories per Year

Types of Cases	Number	Minimum	Maximum	Mean	SD	Total (All Labs)
DNA Convicted Offender	38	0	50,000	3,186.53	10,419.23	121,088
PCR DNA	47	0	17,000	370.77	2,478.46	17,426
Toxicology	41	0	3,000	88.44	470.43	3,626
Mitochondrial DNA	41	0	100	4.05	15.52	166
Questioned Document	40	0	50	1.95	8.04	78
Hair	41	0	10	0.76	2.34	31

Identification						
Ballistics	43	0	10	0.47	1.78	20
Fiber Identification	41	0	5	0.32	1.17	13
Controlled Substance	41	0	1	0.02	0.16	1
Total						142,449

Directors were asked the extent to which they agreed or disagreed with information specific to performance pressure experienced by forensic scientists in their laboratory. Table 4 provides the average ratings, rank-ordered by items from highest to lowest agreement. For example, directors strongly agreed that scientists have the proper equipment to do the job and that scientists are adequately trained in scientific methods (3.98 on a 5-point scale). They also strongly agreed that forensic scientists are pressured to complete cases in a timely manner (3.89) and that scientists are adequately trained to perform the job (3.85). Directors agreed that forensic scientists are comfortable with the quality of the analyses per item (3.72) and that scientists are adequately trained in scientific testimony (3.44). However, they disagreed that scientists are pressured to complete cases too quickly (2.44) and strongly disagreed that scientists are pressured to extend opinions beyond scientific methods (1.78). Directors also strongly disagreed that scientists are pressured to get a particular result (1.47).

Table 4: Forensic Scientist Performance

Statement	Mean	SD	Rank
Forensic Scientists (FSs) have the proper equipment to do the job	3.98*	1.30	1
FSs are adequately trained in scientific methods	3.98	1.33	1
FSs are pressured to complete cases in a timely manner	3.89	1.29	3
FSs are adequately trained to perform the job	3.85	1.31	4
FSs are comfortable with the quality of analyses per item	3.72	1.39	5
FSs are adequately trained in scientific testimony	3.44	1.33	6
FSs have enough time to perform the job	3.16	1.29	7
FSs get enough information from investigators to do the job	3.11	1.33	8
FSs have enough time to prepare for courtroom testimony	3.09	1.30	9
FSs have adequate resources to perform the job	3.09	1.48	9
FSs have the needed resources to provide courtroom testimony	3.05	1.37	11
FSs receive adequate posttrial critiques	2.84	1.42	12
FSs get enough information from the DA to do the job	2.78	1.29	13
FSs would like to analyze more items per case	2.73	1.30	14
FSs are pressured to complete cases too quickly	2.44	1.32	15
FSs are pressured to extend opinions	1.78	1.18	16

beyond scientific methods			
FSs are pressured to get a particular result	1.47	.94	17

*Scale 1–5; 1 = Strongly Disagree; 5 = Strongly Agree

Previous research (Dale and Becker 2003) suggests that one forensic scientist is needed for approximately every 30,000 in the population. We estimated the ideal number of forensic scientists needed for each of the respondents. Then we subtracted the actual number of forensic scientists in each laboratory to develop an estimate of the number of extra forensic scientists needed (per capita) for each laboratory. On average, the forensic laboratories in our sample need almost 50 additional scientists to meet current demand for services.

Next, we examined the relationship between present laboratory capacity, pressure on forensic scientists to perform, and outsourcing; Figures 1–5 present the significant correlations for these relationships. Figure 1 presents the significant correlations between the present capacity in DNA casework and DNA convicted offender work and the pressure to perform. Significant correlations for present capacity variables (number of cases that are currently completed) are discussed first. The number of DNA cases completed was significantly related to the desire to analyze more items per case (0.35; $p < 0.01$), pressure to complete cases too quickly (0.41; $p < 0.05$), pressure to extend opinions beyond scientific methods (0.54; $p < 0.01$), and pressure to get a particular result (0.55; $p < 0.01$). The number of DNA cases completed was significantly negatively related to having enough time to prepare for courtroom testimony (–0.45; $p < 0.01$), having enough time to do the job (–0.43; $p < 0.01$), having the proper equipment to do the job (–0.40; $p < 0.05$), and having adequate resources to do the job (–0.35; $p < 0.05$).

Figure 1: DNA Casework Capacity vs. Performance Pressure

Figure 2 presents significant correlations between present capacity in toxicology and questioned document cases and performance pressure. The number of toxicology cases currently completed was significantly related to the desire to analyze more items per case (0.47; $p < 0.01$), pressure to get a particular result (0.47; $p < 0.01$), and pressure to extend opinions beyond scientific methods (0.44; $p < 0.05$). The number of toxicology cases completed was significantly negatively related to having the proper equipment to do the job (–0.54; $p < 0.01$), having enough time to do the job (–0.45; $p < 0.05$), and having enough time to prepare for courtroom testimony (–0.46; $p < 0.01$). The number of questioned document cases completed was significantly related to pressure to extend opinions beyond scientific methods (0.40; $p < 0.05$) and pressure to get a particular result (0.58; $p < 0.01$).

Figure 2: Toxicology and Questioned Document Casework Capacity vs. Performance Pressure

Figure 3 presents significant correlations between present narcotics capacity and performance pressure. The number of narcotics cases completed was significantly negatively related to having enough time to prepare for courtroom testimony (–0.52; $p < 0.01$), having the needed resources to provide courtroom testimony (–0.49; $p < 0.01$), being adequately trained in scientific methods (–0.46; $p < 0.01$), having scientists adequately trained to perform the job (–0.46; $p < 0.01$), having enough information from the district attorney (DA) to do the job (–0.37; $p < .01$), and having enough information from investigators to do the job (–0.37; $p < 0.05$).

Figure 3: Narcotics Casework Capacity vs. Performance Pressure

Figure 4 provides correlations between present capacity and cases that were

outsourced. The number of DNA convicted offender cases currently completed per scientist per month (capacity) was significantly related to the number of DNA convicted offender cases outsourced to private laboratories per year (0.96; $p < 0.01$). DNA casework capacity was significantly related to the number of DNA cases outsourced to private laboratories per year (0.61, $p < 0.001$).

Figure 4: Capacity vs. Outsourcing

Figure 5 provides significant correlations for pressure to perform and outsourcing. The number of DNA cases outsourced to private laboratories each year was significantly related to pressure to complete cases too quickly (0.29; $p < 0.05$) and significantly negatively related to getting enough information from investigators to do the job (–0.34; $p < 0.05$) and having enough time to prepare for courtroom testimony (–0.30; $p < 0.05$). The number of mitochondrial DNA cases outsourced to private laboratories each year was significantly related to the pressure to complete cases too quickly (0.31; $p < 0.05$) and the desire to analyze more items per case (0.32; $p < 0.05$) and significantly negatively related to getting enough information from investigators to do the job (–0.38; $p < 0.05$) and having the needed resources to provide courtroom testimony (–0.32; $p < 0.05$). The number of fiber identification cases sent to private laboratories per year was significantly negatively related to adequate training in scientific testimony (–0.36; $p < 0.05$).

Figure 5: Performance Pressure vs. Outsourcing

The laboratory directors surveyed also provided miscellaneous comments. One director stated that stable funding is needed for additional full-time staff and training. Another director commented that DNA is the only unit of the laboratory that is understaffed because of the demands of STR analysis; 20–30 percent of the demand concerns demands by prosecutors and detectives for an excessive number of redundant items. Another director commented that the average analyst time for a clandestine-laboratory case is 40 hours, or four cases per month; this laboratory completed 127 clandestine-laboratory cases last year, requiring both field-call response and analysis. Another director stressed that more forensic scientists are essential to ensure more timely analyses of major cases. The inclusion of burglaries and property crimes in the DNA convicted offender database increases the hit rate significantly.

On the issue of the independence of forensic laboratories, we received a wide range of responses. One director stated that there must be significant line-authority separation in laboratories and that a sworn officer leading the laboratory can create a negative impression, whether justified or not. Another director stated that laboratories should be independent, not only of police but also independent of, or at least removed from, the prosecuting attorney's office. One director commented that there are advantages to being a part of a police organization, that there are good laboratories in both camps, and that the type of parent organization does not determine the quality of the laboratory. Another director stated that police agencies have better political resources to address laboratory budgetary issues.

Staffing Levels, Outsourcing, and Pressure to Perform

This project represents the first national survey of which we are aware to examine the relationship between staffing levels, outsourcing, and performance pressure in public forensic laboratories. There is a relationship between current capacity and outsourcing cases to private laboratories. Significant and positive correlations between laboratory capacity and the number of cases outsourced were noted. Capacity was defined as the number of cases per month analyzed by a forensic scientist. As convicted offender case capacity increased, the number of DNA convicted offender cases outsourced increased significantly. As DNA casework capacity increased, DNA casework outsourced to private

laboratories increased significantly.

We suspect that as a laboratory's capacity increases, the organizational culture to allow outsourcing also increases. It should be noted that the outsourcing of cases is typically funded in the United States by grants from the National Institute of Justice. Without these funds, there would be little outsourcing of DNA casework or DNA convicted offender work. The lack of dedicated funding for increasing public laboratory capacity through other means (such as robotics and process reengineering) may firmly establish the current trend to outsource. The issue involves how stakeholders (prosecutors, police, victims, suspects, defendants, and taxpayers) receive the best value for tax dollars. Further research is needed to compare the cost-benefit ratios for private versus public laboratories.

Twenty-two significant correlations between laboratory capacity and the pressure to perform were noted. Significant correlations all involved four capacity functions: DNA casework, narcotics, toxicology, and questioned documents. Eight of these significant correlations involved DNA casework. As DNA casework capacity increased, pressure to complete cases too quickly, pressure to extend opinions beyond scientific methods, and pressure to get a particular result increased significantly. At issue here may be that large-capacity laboratories are victims of their own success: demand *increases* as capacity increases. One might predict that as productivity increases, the pressure to complete a case would decrease. However, our data demonstrate increased pressure on forensic scientists. We suspect that as stakeholders (prosecutors, police, etc.) become more aware of the power of DNA technology, they want it done on all cases immediately.

Capacity and quality of a laboratory with fixed staffing resources represent a trade-off situation. Increasing capacity with a given number of forensic scientists decreases resources needed for quality assurance functions. A reengineering of the total process would help increase capacity and maintain quality. One strategy to accomplish this is through increased use of robotics and batch processing.

Regarding the relationship between capacity and pressure to perform, of particular interest are four significantly negative correlations with DNA casework. As capacity increased, having the proper equipment to do the job, having enough time to perform the job, having adequate resources to do the job, and having enough time to prepare for courtroom testimony all decreased. It may be that the larger-capacity laboratories are enjoying the successful prosecution of many cases and exclusions of many suspects before arrest. However, the successful programs and the publicity inherent in many of the high-profile cases have severely stressed already inadequate resources. The demand for analyses is exponential, and current capacity increases in small and sporadic steps, funded by inadequate public agencies that are now cutting back in all budget categories.

In addition, there were six significantly negative relationships between narcotics capacity and the pressure-to-perform items. For example, as capacity in narcotics increased, receiving adequate training, having enough information from the DA, having enough information from investigators, having enough time to prepare for courtroom testimony, having the needed resources to provide courtroom testimony, and being adequately trained in scientific methods all significantly decreased. Increased burden in the controlled substance discipline is also noted in a recent Bureau of Justice Statistics survey (Peterson and Hickman 2005). In addition, six significant correlations occurred between toxicology capacity and the "pressure" items. As toxicology capacity increased, the desire to analyze more items increased, pressure to get a particular result increased, and pressure to extend opinions beyond scientific methods increased. As toxicology capacity increased, having the proper equipment decreased, having enough time to do the job decreased, and having enough

time to prepare for courtroom testimony decreased significantly. Finally, as capacity for questioned documents increased, pressure to extend opinion beyond scientific methods and pressure to obtain a particular result both increased significantly. Pressure and capacity correlations for the first time corroborated the dynamic environment of the public laboratories. Our data show that specifically in DNA, there are increased pressures to perform. As laboratory capacity increases, the customers—police and prosecutors—want even more analyses done. Thus the laboratories experience more pressure and are "damned if they do and damned if they don't."

Finally, there were eight significant correlations between increased pressure on forensic scientists and the number of cases outsourced. Specifically, these positive correlations indicate that laboratories with scientists who are pressured to complete cases too quickly are significantly likely to outsource PCR DNA and mitochondrial cases. Laboratories with scientists who would like to analyze more items per case are significantly more likely to outsource mitochondrial DNA cases. Laboratories with scientists who receive enough information from investigators to do the job are significantly less likely to outsource PCR DNA and mitochondrial DNA cases. The direct relationship between pressure to complete cases and outsourcing further corroborates the current trend to privatize forensic laboratories. The outsourcing of samples is now primarily driven by federal grant funds to address the large backlog of DNA cases. The fiscal officers of local, state, and federal agencies will soon, if they have not already, compare the efficiencies of the public to the private laboratories. The current economic downtrend and its expected long duration will draw even more attention to any lack of efficiencies in the public laboratories. Public laboratories must learn to work smarter by leveraging technology using robotics, batch processing, and human resource strategies to decrease the costs of voluntary turnover of forensic scientists.

Study Limitations

Web-based surveys are subject to at least three possible sources of error (Couper 2000; Dillman 2000). These concern sampling, nonresponse, and measurement error. Sampling error could have occurred to the extent that not all laboratory directors are represented in the survey. We used an e-mail list from a professional organization, but it is possible that not all directors are contained on this list. Nonresponse error occurs to the extent that not all people included in the sample are willing and able to participate in the survey. E-mail surveys can fail to reach the response rates of traditional mail surveys because motivating tools—such as advance letters, personalized signatures, letterhead, and incentives—cannot be implemented in the same way as in mail surveys (Couper 2000). The nonresponse rate for this survey may be difficult to establish. We administered the survey during the month of December; the holiday season may have negatively impacted response rate. Finally, measurement error could arise from the participants or from the instrument itself. Participants may have lacked the motivation or deliberately distorted or not fully comprehended the survey. Future research should take into account these study limitations.

Because all study variables were measured as self-reports from laboratory directors as a single source, results are limited because of common method variance. Future research is needed using multiple sources of laboratory performance—from employees, customers (e.g., district attorneys, detectives, etc.), and other stakeholders.

Conclusion

This study provides further insight into staffing and performance issues in forensic science laboratories; as such, the findings represent an important contribution to the field. Critical issues—such as the importance of the level of professional staffing, pressure experienced by forensic scientists, and the issue

of outsourcing—need to be addressed further.

Increased reliance on private laboratories raises critical questions. For example, how will a trend toward outsourcing and/or privatization impact public laboratories? Will public laboratories outsource only the routine, redundant cases? Or will continued budget shortfalls ultimately bring about a downsizing or even the demise of public laboratories? Should a different pay structure be implemented for DNA analyses that takes these issues into consideration? Should a price be put on DNA analyses that can include or exclude a defendant or free a convicted offender?

Laboratories are increasingly outsourcing (largely DNA cases) to private forensic laboratories. A significant number of grants designed to reduce DNA backlogs are sourced from federal grants, such as the President's DNA Initiative, and there are current calls to do more DNA testing in cases involving property crimes. But federal funding will not continue to be available without limits. Because this research has documented that crime laboratories are, for the most part, underfunded, we stress that better funding sources at the local and state levels are sorely needed.[1]

A Bureau of Justice Statistics survey lends support to our analysis: 41 percent of public crime laboratories outsource cases to private laboratories because of backlogs (Peterson and Hickman 2005). Government funding is often available for outsourcing cases but not permanent hiring (Koussiafes 2004). Yet laboratories may be reluctant to rely on outside help. Even though 79 percent of laboratories did not have a sufficient number of scientists, the majority (71 percent) would not send more cases to private laboratories *even if they had extra funding available* (Becker et al. 2005). Perhaps employees would rather work on their own to resolve backlogs. One laboratory director stated that employee performance in his laboratory increased dramatically when the laboratory began outsourcing. Understanding employee pride of ownership in forensic work is an area for further examination (Becker 2006).

Law enforcement and the adversarial system exert considerable pressure on forensic scientists, pressures that can be related to compromises in ethical responsibilities and obligations (Briody 2002; Lucas 1989; Saks 1989; Walsh 2005). Increases in caseloads and demands for services at the organizational level exacerbate the pressures that scientists experience. We hope that increased dialogue in the forensic science community can address these important staffing issues.

Acknowledgments

[1]We thank an anonymous reviewer for making this point.

This paper represents the opinions of the authors.

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