



PAPER

GENERAL

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Development and Implementation of an Effective Blind Proficiency Testing Program*

ABSTRACT: Blind proficiency testing is ideal for testing crime laboratory personnel because the elements of analyst bias and anticipation are removed. However, sending proficiency tests through the laboratory system as real casework is difficult. The substantial challenges with preparing and administering blind tests may prevent laboratory managers from initiating blind testing. In 2015, the Harris County Institute of Forensic Sciences committed to improving its crime laboratory's proficiency testing program by adding blind tests. The goal was to test the whole system, from evidence receipt to report release. With careful planning, trial-and-error, and ongoing assessment of available resources, not only was the program proven to be feasible, but there was also clear understanding of how to optimize our program. In this article, we share our experiences, lessons learned, and program details to assist other forensic service providers with developing their own blind testing programs, which would ultimately lead to improved quality assurance.

KEYWORDS: forensic science, quality assurance, proficiency testing, blind testing, verification, quality improvement

Proficiency testing is a regular, planned activity of every accredited crime laboratory as a means to demonstrate the continued competence of personnel, as well as the effectiveness of analytical operations. While some laboratories have developed proficiency testing programs that are more stringent than the minimum standards set forth by their accrediting bodies (e.g., testing frequency, number of personnel involved, and areas of operations tested), open proficiency testing is far more common than blind proficiency testing. A 2014 Bureau of Justice Statistics report estimated that only 10% of publicly funded crime laboratories were conducting blind proficiency testing (1). The absence of blind proficiency testing in the forensic field is not due to a lack of understanding its necessity; rather, it is because of the difficulty in successful implementation.

An open proficiency test, which is a practical test given to an analyst who is aware of being tested, carries several disadvantages. First, most test samples purchased through external providers are relatively easy to test, when compared to normal casework. This is partly because laboratories have different protocols, and external test providers must utilize standard samples that can be successfully analyzed by personnel from different laboratories. Second, a test sample does not generally appear like a typical casework sample; laboratory personnel are likely to be focused on the fact that they are taking a test and take extra care while working with it. Moreover, even though they may be instructed to treat test samples in the same manner as case

samples, analysts are often unable to do so. Some analysts may even be inclined to anticipate the results they believe they should obtain, commonly known as the "Hawthorne effect" (2). This is contradictory to the intent of proficiency testing. In contrast, a blind proficiency test is a practical test taken by an examiner who is unaware of being tested. Blind proficiency testing, when executed successfully, can offset most of the issues that arise with open proficiency testing.

Blind proficiency testing should not be confused with blind verification, where an analyst's results and conclusions are confirmed by a second analyst who has no knowledge of the findings of the first analyst. Blind verification can augment the robustness of a laboratory's proficiency testing program as it is intended to determine if two analysts can independently arrive at the same conclusion without prior knowledge of each other's work. Both blind testing and blind verification remove the element of confirmation bias produced by the nature of the examination (3,4). While both techniques elevate the level of assuredness a laboratory can provide regarding the reliability of its personnel and operations, we focus here only on blind proficiency testing.

Two purposes exist for blind proficiency testing in the laboratory: (i) to measure a laboratory error rate and (ii) to ensure laboratory compliance with standards (5,6). If the goal of a program involves the former, to study error rates, then testing must be frequent and numerous test samples should be submitted within a defined time period. On the other hand, if the goal of the program is solely to ensure quality and identify problem areas, then a lower testing frequency is acceptable. Programs built around either one or both of these purposes, when effectively managed with adequate investigation of issues, corrective action and follow up, should ultimately lead to improved performance and quality of service.

The DNA Act of 1994 included a congressional mandate for a blind proficiency testing feasibility project, so that

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recommendations could be made to the National Institute of Justice (NIJ) on whether blind external proficiency testing is possible and practicable for DNA testing laboratories (7). After approximately four years of extensive study and carefully constructed trials, the NIJ-appointed National Forensic DNA Review Panel recommended, in short, that blind proficiency testing programs be deferred. The findings were that, although possible, blind testing was too problematic to implement and maintain, both financially and logistically (8).

More than two decades have passed since that study concluded. Not only has technology advanced, but there has also been increasing sentiment toward higher levels of quality assurance. For example, in the mid-1990s, accreditation had not yet been fully embraced by the forensic community; crime laboratories needed to “buy-in” to that concept prior to any other quality assurance endeavor (8). Only half (56%) of forensic DNA testing laboratories were accredited in 1998 (9). Later studies conducted by the Bureau of Justice Statistics showed the percentage of publicly funded crime laboratories that were accredited jumped from 70% in 2002 to 88% by 2014 (1).

A second point to keep in mind is that the NIJ advisory panel was evaluating feasibility and costs of a large-scale program (i.e., inter-laboratory and nation-wide). Indeed, those costs would be high. However, the costs associated with an internal blind proficiency testing program tailored to checking in-house operations for a single laboratory or laboratory system are manageable. In this article, we discuss factors related to the development of our own blind proficiency testing program, one of a smaller scale, which could serve as a stepping-stone toward an expanded program. When considering the different goals of the NIJ advisory panel and our own nascent program, in addition to what has changed since the DNA Act of 1994, it is our position that some of the concerns surrounding the feasibility of blind proficiency testing are no longer valid.

In 2015, the Harris County Institute of Forensic Sciences (HCIFS) Quality Management Division developed and implemented a blind proficiency testing program for the Institute’s crime laboratory. The goal of this internal blind testing program was not to establish error rates; rather, it was to have a means for checking the laboratory system as a whole to identify problems and areas requiring improvement. Quality Management personnel drew from several sources to ensure the effectiveness of each test, including purchasing some specimens from external providers, and collaborated with law enforcement personnel who routinely submit evidence, as well as the laboratory’s evidence-receiving staff. The result was the creation of a wide array of custom-made, typically packaged test “evidence” that could be shuttled through the system as normal casework for each laboratory discipline.

A unique set of challenges presented for consideration when this new program was launched. Concealing the planning efforts so the laboratory staff would remain uninformed proved to be the biggest challenge, both logistically and from an ethical standpoint. Managing the blind test cases in the laboratory information management system (LIMS) also proved to be difficult. Additionally, decisions needed to be made regarding the disclosure of test results to management and test participants. These concerns, while substantial, were eventually addressed after various proposals were evaluated for best fit. Thus, effectively incorporating blind proficiency testing into the quality assurance program for a crime laboratory can be challenging at first, but it is achievable and is recommended as a means to increase the overall confidence in laboratory performance.

Benefits to Users of Blind Testing

There are numerous benefits of blind proficiency testing, which substantiate its advantage over open proficiency testing, for both management and the individual analyst. From a management perspective, blind testing is a more accurate check of the laboratory system and therefore allows for a better understanding of the whole system as well as discrete aspects of it, such as the analysis method, standard operating procedure, and review process (10). For example, if the wrong result is obtained, then the analysis method, data collected, instruments involved, and staff who carried out the procedures should be reviewed. If the correct result is obtained but the case record indicates the standard operating procedure was not followed, either during analysis or peer review, then the procedures, staff carrying them out, and training of those staff members on the procedures should be evaluated.

In the event an issue is identified during the evaluation of the test results, management must undergo the corrective action process, which first requires a proper root cause analysis (11). During investigation of possible causes and determining the root cause, management is forced to look at the steps involved in the area of interest, how they are connected, who is involved in carrying them out, and if any gaps exist, thus reinforcing a process approach to troubleshooting. The eventual corrective action ultimately leads to an improvement of the testing system. Although corrective actions do result from deficiencies identified during open proficiency testing, certain deficiencies may never be identified without blind testing; laboratory personnel are unaware they are being evaluated with a blind test and are not primed to “over-perform” or self-correct, making blind checks more effective at finding potential problems than those accomplished through open proficiency tests.

Early analysis shows that the HCIFS laboratory’s proficiency test success rates are similar for open and blind testing; however, root cause analyses of unsatisfactory test outcomes in both programs revealed potential issues that lie within different areas for each. The nonconformances identified during blind proficiency testing have mainly occurred in areas that involve subjective interpretation on the analyst’s part. These nonconformances would not have come to light otherwise, which underscores the need for blind testing.

On an individual level, any legitimate test completed successfully lends value and credibility to an analyst or examiner. Yet some tests are more valuable than others. While an open proficiency test may speak to an analyst’s knowledge and skills in the area being tested, a blind proficiency test can also speak to the analyst’s integrity because it demonstrates consistent adherence to the laboratory’s established procedures when handling evidence, reporting results, and/or reviewing data. In other words, it confirms that the analyst properly follows procedures every time, with each case, even when no one is supposedly “watching.” This makes it easier to evaluate whether an analyst is trustworthy and ethical, two things that can come into question on the witness stand. An analyst who undergoes blind testing can explain the process to the jury and reference it during testimony when asked to describe any quality control measures of his or her work.

The triers of fact for a trial are not the only stakeholders affected by a successful laboratory proficiency testing program, but the community that the laboratory serves is also an interested party. Citizens need assurance that laboratory personnel will not take shortcuts as a means to reduce case turnaround times. What

assurances are there for complainants, defendants, and the families of victims that their particular cases were not rushed through testing in a manner that compromised quality? Regular blind testing of laboratory personnel attests to a laboratory's commitment to cases consistently being handled properly, regardless of pressure to work at a rapid pace. This helps the laboratory to maintain the trust of the community. It communicates integrity as well as competency of laboratory employees. Thus, in the realm of professional practice, a blind test completed successfully means more to a stakeholder than a successfully completed open proficiency test.

Program Design

Enlisting Law Enforcement Assistance

Developing an effective blind proficiency testing program requires a comprehensive understanding of laboratory operations, and it will inevitably involve some trial and error. At the HCIFS, Quality Management personnel reached out to local law enforcement officials and other submitting agencies to discuss possibilities for their involvement in the program. This occurred only after it became clear the program would not be successful unless the usual submitters of evidence were the ones to submit mock evidence for a blind test. For some law enforcement agencies, an in-person meeting with decision-makers was necessary to start the discussion, while other agencies responded well to a formal letter requesting their assistance. Either way, these agencies were receptive to the idea once they understood that the goal of the program is to assess and improve the quality of work provided to them.

The advantage of having a submitting agency on board includes (i) having their officers complete the evidence submission forms for test samples in the same manner as they do for normal casework, (ii) obtaining their assistance with packaging the mock evidence in a typical fashion, and (iii) being able to utilize their case numbering/barcoding system(s), where applicable. Each of these topics should be discussed at length with the participating submitting agencies, particularly how to use the agency's case numbering and/or barcoding system in a manner that will not interfere with real case tracking. All of these matters require smart planning so as not to tip off the analysts, while also having a mutual understanding that the program should not be too burdensome for the submitting agency. For instance, agreeing on a reasonable frequency of blind test submissions beforehand will ensure ongoing participation of the law enforcement agency. We found that working together on the logistics of test case submission procedures led to improved relationships with participating submitting agencies – an unanticipated bonus of the program.

Determining an appropriate number of test cases per month or per year is not only important for controlling the burden placed on the submitting agency, but it is also a key consideration for the laboratory disciplines that have challenges in managing backlogs or maintaining reasonable turnaround times. At HCIFS, Quality Management is informed on each laboratory section's productivity, in order to evaluate each laboratory section's ability to accommodate additional proficiency tests. The program should be designed so it does not markedly hinder productivity or place unnecessary stress on the analysts (e.g., cause the need to work overtime or lead to rushing through casework).

It is suggested that submitting agencies designate personnel to be fully informed of the blind testing program and serve as

either case officers named on the evidence submission forms or the submitters of the test case evidence during their usual runs. Once a test case is submitted, just as in normal casework, there is a chance an analyst or technician will try to contact an officer about the case or submitted items. For this reason, it is important that the officer listed on the test evidence submission form, either as submitting officer or investigating case officer, is among those who are aware of the blind testing program. If laboratory personnel email or call an officer with questions, the officer will be able to identify the case as a blind test when looking it up in their system, and appropriately "play along" when responding.

General Preparation of Mock Evidence

The physical preparation of mock evidence presents several challenges. While the submitting officers can assist with outer packaging of mock evidence if need be, the inner packaging, if any is usually present, must mimic real case evidence, and so must the samples themselves. Again, it is imperative that the test preparers familiarize themselves with the laboratory's normal casework as much as possible. The Institute's Quality Management personnel had numerous opportunities to get a good grasp on the look of routine evidence submissions prior to developing the blind testing program. Observing analysts handling casework at the evidence-receiving step or the evidence processing steps in the laboratory is instructive. Taking advantage of observation opportunities during internal audits of the laboratory disciplines is also an effective way to gather observations. Reviewing case records that contain photos of evidence and markings from hospital staff or officers is useful in this capacity as well. At the Institute, Quality Management personnel regularly perform random case reviews for each laboratory discipline, and this allows them to become familiar with the appearance of different types of evidence items.

Equally important, laboratory personnel must not see mock evidence being prepared. At the program's inception, Quality Management personnel would stay afterhours or come in on weekends to prepare and package the samples in the crime laboratory area. A few years later, the main operation of HCIFS moved to a newly built facility which houses a separate quality assurance laboratory. This allows Quality Management staff to prepare test cases during normal business hours, out of sight of crime laboratory personnel.

The test preparers must refrain from marking the samples with in-house test identifiers. Only the submitting agency case number or offense number should be printed on the evidence packaging. These agency numbers may be printed on sample containers, too, if the number is communicated by the submitting agency to the test preparer prior to packaging the test evidence. Once the agency case number is known, an in-house identifier can be created and linked to the given case number, via a spreadsheet or otherwise, for the test preparers' knowledge only, to serve as a test key. It is recommended that all crucial test information be recorded together, such as date of test preparation, name of test preparer, materials submitted, and expected results. Test results can be recorded there as well and compared to the expected results.

Databasing and Disclosure Issues

It is important to take into consideration the uploading of casework information to databases. As examples, firearms

laboratories utilize the National Integrated Ballistic Information Network (NIBIN) and DNA laboratories participate in the Combined DNA Index System (CODIS). There must be safeguards in place to prevent blind test result uploads into those databases. The Institute's Quality Management Division decided that database upload and subsequent database hit management should be excluded from being blind tested due to the ramifications of noncasework data being entered into these databases. In other words, although database entry and management are important parts of certain disciplines' operations, databasing may be the only exception for the blind testing program. Tests are worked through interpretation and peer review, but a laboratory manager will intervene in time to prevent the actual data upload into a database.

Another issue that required careful planning was disclosure to participants after a test is completed. Informing analysts that they conducted a blind test could jeopardize the future success of the blind testing program. If analysts were to recognize submitted items as blind tests, it would compromise the blind component. Eventually, we elected to notify test participants of their test results as is done with open proficiency tests, but without telling them which cases were tests. Memos of completion are now issued to the analysts and reviewers in each test case, informing them if results were consistent or inconsistent with expected results. Just as is done with open proficiency tests, any inconsistency identified in a blind test is investigated as a nonconformance and corrective action is implemented, when appropriate. The test participants do not see any test identifiers on the memo, only an alphanumeric code, so as not to tip them off about which case was a test case. These notifications provide laboratory personnel with documentation of their blind proficiency tests, so they can remain informed about their own progress as well as use it to support their testimony in court.

Ethics questions arose in the beginning of the blind testing program. There were concerns about the level of deception being imposed on the crime laboratory staff, both from Quality Management staff and the law enforcement officers involved. Our relationships are supposed to be built on mutual trust; therefore, fabricating stories or lying about alleged case details when communicating about mock evidence may seem wrong. It was decided that efforts to conceal blind tests as casework must involve some level of deception. The benefit of the program, which is improved quality assurance within the laboratory, justifies the required deception. Furthermore, the existence of the program was announced to the laboratory section managers and the crime laboratory staff. They know they are being tested blindly, even though they do not know when or how often.

Costs of the Program

The costs associated with developing and sustaining a blind proficiency testing program could range widely, depending on the level of "do it yourself" the test preparers choose. The test samples can be prepared from scratch, merely requiring materials to be purchased from a store or hobby shop at low cost to start. Alternatively, external proficiency tests can be purchased at high cost, to serve as the starting point for preparing a series of mock evidence samples. Purchased external proficiency tests would require repackaging in containers and inner packaging typical of those used by local submitters, at the very least, but they may also require further manipulation to make the samples appear more like real evidence samples. For example, most seized drugs proficiency test samples appear as clean, pure powders – nothing

like the "street" samples typically received through law enforcement seizures. Submitting these types of pristine samples to the laboratory could reveal the test to the analysts. Thus, purchased samples must be mixed or altered to look more genuine.

Along those lines, custom tests can be ordered from external test providers, which have proven to be beneficial for some of the laboratory disciplines (e.g., blood tubes for toxicology testing). However, both the packaging and the sample containers in custom tests tend to come premarked with test provider identifiers and cannot easily be disguised as routine casework. An external provider may offer to work directly with a submitting agency for a laboratory, promising to deliver a custom test to the law enforcement agency for subsequent laboratory submission. However, this would be at an additional cost, and it is unlikely that the test evidence would closely mimic real evidence since the vendor is unlikely to be familiar with the nuances of each region's typical evidence submissions. This last option is, therefore, not recommended.

At the HCIFS, the additional costs associated with the in-house blind proficiency testing program are estimated each year and added to Quality Management's annual proposed budget. As the program has advanced, more tests are being prepared each year and costs have increased. Table 1 shows an example of the program's estimated cost, excluding personnel costs for those involved in test preparation and administration.

Discipline-Specific Notables

The HCIFS crime laboratory includes the disciplines of serology/DNA, seized drugs, toxicology, firearms, and trace evidence. Each discipline has a specific set of evidence submission requirements; therefore, the preparers of mock evidence for blind testing had to learn how to customize the mock evidence and combat the different issues involved for each category of testing. Below are some examples of lessons learned during the program-development phase for each laboratory discipline, with many of the details specific to what is typical for Harris County, and not necessarily other regions.

Toxicology appeared to be the easiest discipline to blind test because DUI/DWI testing only requires blood collected in gray top tubes. Gray top tubes come with two additives – potassium oxalate, which prevents blood clotting, and sodium fluoride, which inhibits glucose fermentation. Blood samples in gray top tubes can be purchased through an external proficiency test provider. These typically come in 5-mL tubes, instead of the usual 10-mL tubes that law enforcement submits. Therefore, the blood should be transferred to a new 10-mL gray top tube upon receipt and repackaged to mimic law enforcement packaging. When transferring blood to a new tube, the additives should be removed from the new tube to keep from augmenting the amount of additive already in the blood. Extra sodium fluoride may lower the alcohol content in the blood, which could lead to inconsistencies between expected and observed alcohol concentration results.

A potential issue to be aware of when using external tests as internal blind tests for drug concentration testing of blood samples is that some manufacturers prepare their blood samples using a high level of methanol in the drug stock solution. If these blood samples were tested for volatiles in the toxicology laboratory in addition to routine drug testing, the unusually high methanol level would be a red flag to laboratory staff, possibly alerting them to the fact that they are testing mock evidence. Therefore, the test preparers should be aware of all components, and their relative amounts, present in the samples they submit.

TABLE 1—Cost of materials for preparing one year's worth of blind tests.

Discipline	Category of Testing	Prepurchased External Tests	In-House Materials	Cost
Toxicology	DUI/DWI	3 at \$40 each		\$ 120
		2 at \$190 each		\$ 380
			Gray top tubes (100)	\$ 97
			Plastic pipettes (500)	\$ 50
			Blood collection kits (5 kits)	\$ 45
Seized Drugs	Drug Identification	2 at \$198 each		\$ 396
		2 at \$90 each		\$ 180
			Plastic sandwich bags (100)	\$ 4
			Mini resealable bags (100)	\$ 5
			Soda drinks (3)	\$ 3
			Cough syrup (2)	\$ 20
		Infant formula powder (12 oz)	\$ 18	
Trace Evidence	Gunshot Residue	2 at \$300 each		\$ 600
			GSR stubs (1 set of 2 stubs)	\$ 4
Trace Evidence	Fire Debris	2 at \$105 each		\$ 210
			Paint cans (2)	\$ 6
Firearms	Comparison		Ammunition (50)	\$ 15
DNA	Sexual Assault		Sexual assault kits (2 kits)	\$ 30
			Additional cotton swabs (1000)	\$ 16
			Store brand panties (3-pack)	\$ 11
			Manilla envelopes (100)	\$ 16
			Barcode labels (400)	\$ 80
			Scalpels (20)	\$ 35
			Evidence tape (108')	\$ 15
Total				\$ 2,356

DUI/DWI, driving under the influence/driving while intoxicated.

Although the HCIFS offers postmortem toxicology testing in-house, blind tests have not yet been developed for that service.

Seized Drugs is another discipline for which vendor samples are used. However, these purchased samples come in neatly packaged pure powders, as mentioned earlier; thus, they do not appear "street-like." Purchased zip lock baggies of different sizes and used, empty prescription drug containers are useful for repackaging drug evidence for submission. For white powders, purchasing larger resealable baggies, repackaging, cutting off the zip lock ends, and tying into a knot assists with making the submission appear more authentic. Smaller baggies are another alternative since these are used on the street as well. The test preparer can perform simple actions, such as balling up or rolling up the baggies several times prior to using, in order to simulate the appearance of normal wear and tear (i.e., making it appear as if it had been in someone's pocket). Adding commonly used cutting agents to powders also assists with sample authenticity. Additionally, purchasing plastic soda bottles to mix in a purchased drug or over-the-counter syrup has proven to be successful in testing for the popular types of spiked drinks that are often confiscated from young adults in our region.

Trace Evidence at the Institute offers gunshot residue testing (GSR) and fire debris analysis. Vendors are available to provide samples for both. GSR stubs arrive with test provider stickers on them that must be removed or adequately covered with "agency" stickers. Previously analyzed GSR stubs should not be reused. Although the evidence is not destroyed during analysis, the stubs are chemically coated prior to loading onto the instrument for analysis (i.e., the scanning electron microscope), a process that should not be repeated too often if optimal results are to be achieved. Furthermore, if the laboratory places their own markings on the stubs during processing, stubs cannot be reused for internal blind tests unless the test preparer is able to remove the markings.

Fire debris samples arrive from the vendor in heat-sealed bags, not how law enforcement submits this type of evidence.

Therefore, the samples must be transferred to an empty paint can or other type of tin can first. Additionally, the samples should be disguised to look more like case evidence (i.e., a neatly cut, clean piece of carpet with identifying markers will not suffice for a blind proficiency test sample). Mixing it with dirt or garbage and/or carefully burning parts to show some charring are useful ways to disguise the samples as authentic. Alternatively, ignitable liquids can be purchased directly, poured on scraps of material (e.g., carpet, curtains, or bedding), and burned briefly in a controlled manner. These homemade items will need to be verified by pretesting prior to submission of the blind test in order to determine if the expected results can be obtained. Burning of mock samples should never be attempted without direct supervision of professional firefighters or fire marshal staff. The Institute partners with the county's Fire Marshal to receive assistance with preparing and submitting fire debris mock evidence.

Firearms exhibits cannot be purchased from external test providers because the items are engraved with the provider's unique identifiers. This makes it impossible to pass off the items as real evidence. At HCIFS, it was necessary to enlist the assistance of a firearms laboratory manager when preparing blind tests since there are currently no proficiency test vendors that are able to supply items for our firearms division (e.g., bullets, cartridge cases, firearms). The Institute's firearms laboratory has a wide range of firearms in their reference collection, as well as a firing tank that can be utilized to create mock evidence items. The firearm managers have worked closely with the Quality Management Division to create mock case samples (where ground truth is known) for an officer to submit to their division. For example, the manager shoots several rounds in their tank, purposefully hitting one of the sides occasionally, to create a damaged look. The same or a different firearm may be used each time, depending on the intended scenario. The manager then verifies the evidence by examining for remarkable findings, so the projectiles could eventually be submitted for comparison to each other.

Serology/DNA is another division that does not easily allow for using external proficiency test samples as blind test samples. Most external providers' tests, even if "custom-made," contain substrates that look nothing like real evidence, such as neatly cut squares of cloth, each with a large symmetrical circle of blood in the middle. The Institute's Quality Management Division creates tests in-house by adding non-DNA laboratory staff member's saliva to both questioned and known mock samples. Swabs are easy to start with, as they are cleaner than clothing. If clothing items worn by individuals other than the DNA sample donors are used for mock evidence, even if washed beforehand, there is a chance a partial DNA profile would be detected that is not one of the intended DNA profiles. This is due to lingering wearer DNA or touch DNA from other people. Unused sexual assault kits serve as excellent material for preparing blind tests.

Reference samples from any saliva donor for tests are taken and analyzed as "QA samples" prior to the blind test submission to verify which DNA profiles are expected to be on the mock evidence. The profiles from QA samples are also entered into the DNA laboratory's in-house database, which is a database housing all single source profiles and profiles deduced from mixtures generated within the laboratory, serving as a tool for detecting DNA contamination and case-to-case association, regardless of CODIS eligibility. A DNA laboratory manager is always informed of a submitted blind test so the manager can monitor the test's progression through the laboratory and intercept it before the CODIS entry step. Additionally, the manager expects to be notified of an in-house database hit once the blind test samples enter the interpretation and review phase of testing. Being notified of this in-house hit becomes part of the blind testing program, as personnel are required to follow specific protocols for searching the in-house database and reporting any hits.

As with any test item produced in-house, the expected results (i.e., criteria for grading the test as satisfactory) must be established prior to administering the test. There are several ways to approach this, including sending the items out to another laboratory for testing. If external pretesting is not an option, a case manager should be involved in ensuring that items are not pretested in-house and then proficiency tested by the same personnel.

Functions performed at a suspected crime scene, such as fire-arm retrieval from an officer-involved shooting or trace DNA collection from a decedent retained by the medical examiner, are currently not blind tested due to the difficulty of effectively staging a crime scene.

Conclusion

Crime laboratory proficiency testing can be improved to better ensure analysts, examiners, and technicians are performing their jobs properly. Open proficiency tests are useful to a certain degree and will always have a place within crime laboratory quality assurance programs; however, blind proficiency tests are better at testing the typical operation of each laboratory staff member and the whole system as it truly is. For those forensic agencies committed to effectively testing their laboratory staff, a blind proficiency testing program should be established.

Lessons learned from our extensive work on an internal blind testing program include designating separate staff to manage the program, designating a separate area for preparing mock

evidence, aligning and coordinating efforts with law enforcement or other customers who submit evidence, and carefully budgeting in advance of implementation. Becoming familiar with the types and appearances of different evidence submitted to each laboratory discipline is crucial to knowing how to adequately disguise mock samples as evidence. Equally important, obtaining prior approval and support by upper management is essential to ensuring the viability of such a high-maintenance program.

The time and resources involved in developing and sustaining an effective blind testing program are not negligible. Significant effort, as described above, is required. Most will find it more challenging to implement than initially perceived. Yet these efforts pay off, as they ensure that the blind tests mimic routine cases as much as possible when being distributed to the laboratory. Bearing in mind other large endeavors to improve quality within the laboratory, a blind proficiency testing program is no different. When high-quality forensic testing is promised to the justice system and the public, it is understood that necessary changes and improvements are not free. Time, planning, and adequate resources are always needed to effect change and to achieve the desired level of service.

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