TESTING OF SIX THOUSAND NO-SUSPECT CASES: WHAT HAVE WE LEARNED

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Abstract

A primary focus of crime laboratories in the late 1990's using DNA identification testing was the testing of convicted offender samples and construction of convicted offender databases. The size of the convicted offender databases have increased rapidly over the past few years due to increased funding and efficiencies of testing. With the convicted offender database testing proceeding well, the primary focus of crime laboratories in the 21st century is on the testing of probative samples from no-suspect cases. Federal funding for testing of no-suspect cases has recently become available, although many state and local jurisdictions have already begun testing. Successes from the testing of no-suspect casework are numerous and the successes will continue to rise at a rapid rate as more and more states begin testing of backlogged cases. For a variety of reasons (e.g., cost, efficiencies of time, personnel, and/or space) some crime laboratories have decided to outsource some or all of their unsolved casework to private laboratories. Over the past two years, the staff in our laboratory has tested over 6000 no-suspect cases received through contracts from several different jurisdictions. Testing on these samples has included presumptive screening for semen and/or screening for sperm, DNA extraction for blood, saliva or mixed stain extraction, and generation of DNA profiles for the 13 CODIS loci. A summary of the information obtained regarding the percentage of cases testing positive and negative for screening tests, for the production of profiles suitable for state or NDIS databases, and for the number of "cold hits" with convicted offenders or other cases will be presented. This information should be helpful to crime laboratories now designing strategies, predicting expenses, and planning testing for future of no-suspect casework.

Introduction

Agencies and laboratories in almost all 50 states participate in the Combined DNA Index System (CODIS) and National DNA Index System (NDIS). The total number of profiles in the NDIS system is currently greater than 1.25 million. This includes approximately 45,000 forensic profiles and 1,200,000 convicted offender profiles as of August 2002. Searches of forensic profiles with the convicted offender databases using CODIS have yielded over 4500 hits and assisted in more than 4,900 investigations. The success of the CODIS program is small considering the possible addition of forensic profiles from an estimated 180,000-500,000 no-suspect cases that are as of yet untested in laboratories and agency property rooms throughout the United States. There are many reasons to reduce backlog of no-suspect cases. These include:

1) Financial support for testing no-suspect cases is available from the National Institute of Justice, and local and state governments
2) In jurisdictions with a statute of limitations for prosecuting crimes, "John Doe" warrants may be issued based on the DNA profile obtained from the testing of evidence in no-suspect cases.
3) Testing may connect serial crimes providing important assistance in investigations and prosecutions.
4) The identification and conviction of perpetrators helps bring closure to victims and/or victim's families. Case closures are an opportunity for positive recognition of the crime laboratory, state's attorney, and police department.
5) In the event that a hit is obtained to an individual incarcerated for another crime, an additional conviction may improve public safety by preventing the individual from being released into the community.
6) Outsourcing of no-suspect cases allows laboratory staff to focus on current cases, research, validation, or other projects.

7) Financial and personnel resources have been expended in the collection and testing for convicted offender samples. The reduction of no-suspect casework and the crimes that will be solved will assist in the justification for continued convicted offender testing and further expansion of the databases (e.g., to include arrestees).

The Orchid Cellmark laboratory in Germantown, MD, participated in convicted offender databasing for approximately four years from 1998 to 2001 testing 8000-10,000 offender samples per year for clients. From this experience higher throughput methodologies and instrumentation were instituted, and many of these efficiencies were employed in the transition to processing large-scale no-suspect casework. Several strategies may be applied to process no-suspect cases. The best strategy will depend on factors that include state contract provisions, federal funding guidelines, and laboratory policies. There are advantages and disadvantages to any testing approach for no-suspect casework. For laboratories that want to open a case a minimum number of times, a strategy may be employed to test all items for DNA. This process will be more time and labor intensive but will allow the most thorough DNA testing. An alternative approach is to screen some or all of the evidence in a case for probative body fluids and then select the best candidate for DNA testing. For sexual assault kits, priority items such as vaginal, oral, anal, and dried secretion swabs may be screened and only a probative sample sent forward for DNA testing. This priority system may be used in a screening program in which the objective is to process a large number of cases in a limited time period.

The Testing Process

Within our laboratory, several variations of the above strategies have been used based on client needs. A variety of sample types including orifice swabs, fingernails, hairs, swabbings of microscope slides, material cuttings, cigarette butts, and amylase-positive samples have been tested. We have developed a workflow process with flexibility to allow samples to enter the workflow at several different points in the system, therefore, accommodating the broad range of client requirements. When shipments are received, accessioning of the samples is performed to verify the shipping manifest. The client is notified of what was received and whether any discrepancies were identified. A unique internal case number is assigned to each external case, and documentation describing the evidence sample(s) and/or reference sample(s) are entered into the laboratory information management system (LIMS). The reference samples are processed separately from the evidence samples, and the data are compared at the end of the testing process.

Most samples that clients have submitted to the laboratory for testing have been from sexual assault cases. If part of the contract, samples are screened for semen that includes using an acid phosphatase (AP) assay, a p30 antigen assay, and/or a slide search for sperm. If positive for AP activity, the sample is sent forward for DNA extraction. Typically if negative, the sample is tested for the presence of the p30 antigen and if positive sent forward for DNA extraction. Extracts for sperm search are prepared from samples negative for AP activity and p30antigen. If no sperm are visualized on the slide, the case is considered negative. A similar program could include screening for blood and/or saliva. In addition to samples entering the workflow for DNA extraction from semen screening, samples have been sent to us to begin testing with DNA extraction. Depending on the type of sample and the contract specifications, a differential or neat extraction procedure (Organic, Qiagen™, Chelex®, or FTA extraction) may be performed. We have learned that extraction in batch sizes that optimize instrument use is the most efficient method of testing. For example, the number of samples for an extraction batch may be limited by the number of samples that a microcentrifuge can hold. DNA extracts have also been received for testing from clients. These samples are quantitated within our laboratory prior to amplification. Quantitation of all DNA extracts is performed using a blotting procedure in either a 48 or 96 well format. The resulting X-ray film is scanned into the computer and analyzed with BioImage™ software. The data are imported into the LIMS program for automated calculation of the dilution and extract volume needed for amplification. Both tube and plate formats are used for amplification. Plate amplification is an opportunity to increase throughput, but sample type and client needs are evaluated in choosing which format to use.

Generally, the higher throughput instrument platforms are more efficient for sample processing; however, the choice of platform to use may be dependent on criteria such as DNA yield and client preference.

Amplified product from samples with low DNA yield may need to be analyzed on more sensitive instruments. Within our laboratory these samples would be analyzed with the ABI Prism® 310 or 3100 Genetic Analyzer rather than the ABI Prism® 377 Genetic Analyzer. Data analysis may be performed with GeneScan® and Genotyper® software, but for high throughput testing a semi-automated software program may assist with interpretation. Final casefolder organization will depend on the client's needs. A folder containing quantitation, amplification, and electrophoresis documentation, as well as electropherograms for controls associated with samples in the batch may be in a single batch folder. The case specific folder contains the sample electropherograms and extraction records for samples from a specific case. We have found this type of folder organization to be more efficient for the large number of samples processed in no-suspect work. If the laboratory requires a paperless system, electronic documentation may be stored for review. Following the technical and administrative review process, the data can be reported to the client in several forms for final review prior to acceptance for CODIS and upload to NDIS. Return of the evidence and DNA extracts can then be coordinated with the submitting agency.

The implementation of a LIMS program has definite advantages for processing no-suspect casework. These advantages include assisting in the maintenance of sample integrity throughout the testing process, assisting in the data upload/download from instrumentation, and data storage and recovery. A LIMS program can include checks that the appropriate controls are performed. The program may identify duplicate profiles as well as assist in other quality controls areas. Use of a LIMS program provides critical assistance in the rapid generation of laboratory reports.

Results

We have been processing large-scale no-suspect cases for approximately two years, and in that time we have tested over 8958 cases. In addition to our standard proficiency-testing program to meet the *Quality Assurance Standards for Forensic DNA Testing Laboratories* and ASCLD/LAB standards, we have successfully completed more than 280 quality control cases that were submitted as blind proficiency tests along with cases/samples from our clients. This method of blind quality assurance is particularly useful to laboratories outsourcing cases. For several of our current contracts, we pre-screen samples for semen. This screening is primarily performed on priority items such as vaginal, anal, oral, and dried secretion swabs. If the priority items were negative, further testing of these cases was not performed at this time, although additional items in these cases may be positive for semen and will be detected in additional testing at a later time. Of the large-scale no-suspect cases tested by Orchid Cellmark, 3258 of the 8958 cases (36%) were screened for semen with greater than 1506 cases (46%) indicating the presence of semen on the limited number of items tested. These positive cases and an additional 5705 cases (total 7211 cases) had DNA testing performed on an evidence sample and reference sample, where available. Profiles from 4306 cases from our laboratory have been entered in CODIS. This is an average of 60% of cases tested for DNA, with a range of 45-88% depending on the contract. Most of these results were obtained with no additional testing or re-extraction of the samples. The number of profiles entered in CODIS will certainly increase as more of the profiles provided to the clients are uploaded and as additional testing is performed on cases based on the original data provided. For example samples with weak male profiles may be re-extracted with improved results using the data from the first extraction, and multiple male donors may be resolved by testing additional evidence samples in the case and/or consensual partners. The data that we have provided clients for their cases have resulted in many hits in the NDIS database. So far, case-to-convicted offender hits have been identified in 256 of the 4306 cases with the range for individual contracts as high as 29%. 175 case-to-case hits (4%) have also been obtained with a range up to 8%. The number of hits will likely increase as the number of completed evidence profiles are added to the database and the number of convicted offender profiles for that state and across the country is increased.

Conclusion

As the data summarized indicate, the hit rates obtained from testing of no-suspect casework should justify the use and expansion of convicted offender databases that have been established and should encourage agencies to process their backlog cases. Further demonstration of the success and court

acceptance of no-suspect casework testing is that several agencies have prosecuted individuals identified through the database hits on data provided by our laboratory from both the forensic and contract teams. Outsourcing, using available local, state and federal funding, is an opportunity to increase the number of cases completed in a shorter time period.

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