FORMULATION AND EVOLUTION OF FORENSIC SCIENCE STANDARDS

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Objective: To provide an overview of the current process for standardization of forensic bodies and relate this process to all law enforcement/security fields. The article will include a brief history of forensic standardization, a look at how standards are formed, and state the importance of these standards for the forensic field. Any security, law enforcement, or forensic personnel should be familiar with these standards as they guide the admissibility of evidence and the outcome of cases.

FORENSIC SCIENCE

The Forensic Science profession consists of a multitude of organizations with a variety of goals, interests, and locations. One of the ways that such an overarching profession can exist is through the development of standards. These standards themselves range from documents such as ethical codes to analytical methods to administrative descriptions, each standard encompassing an aspect of the field it serves. All of these standards are important and most modern forensic companies and practitioners recognize this fact, making standardization easier.

Quality assurance is one of the main focuses in forensic science standardization. The concept employs a "triangle of quality". At its base is standardization where the standard methods and practices of the field are represented. The other two sides consist of certification and accreditation, each side being useless without the other and each relying on that basis of standardization. Certifying bodies require a standard of knowledge from which to develop their rules and examinations. Likewise these bodies enhance standardization by defining the requisite knowledge required for practice and therefore the training and education considered a prerequisite for certification. Likewise, accreditation is meaningless without standards provided to applicant organizations to communicate what is expected.

Helping to design and maintain a quality assurance manual is one of the main functions standards serve in an organization. In thinking about how to apply standards to practice, a good quality assurance document places standards into one of four levels of documentation. Level one typically consists of an organization's mission statement, levels of staffing, goals of the organization as well as each of the subgroups within it, and a description of how the quality assurance manual will be distributed and changed. The manual itself is a level one document. Level two documents describe how the quality assurance program operates including its feedback procedures, corrective/preventative actions, and the frequency of audits both internal and external. The third level of documents consists of the everyday procedures for conducting any major activity of the organization. This level is the most pivotal for an organization as is lays out an accurate description of the organizations work and can be used as a reference should confusion arise. The final level, level four documents are the forms that facilitate the collection of data and information. The actual content of this level of documentation is mandated by level two and three documents, but the documents themselves are part of level four.

SOURCES OF STANDARDS

Courts

Court rulings can affect existing standards in a couple of different ways. Rulings can cause new standards to develop, alter existing standards, or do away with standards all together. They can even change how the entire discipline functions. This was the case in the court rulings in Daubert v. United States which established that experts are required to testify on any presented evidence in a grand jury trial. Prior to this case, the Frye case had established a "general acceptance" ruling simply requiring the methods of analysis to have general acceptance within the scientific community. The Daubert case has drastically changed the training required of experts in the field, as testifying prior to this case was a rarity, though it did not change the rule for qualifying a witness to testify as an expert. These qualifications were established in the cases of Miller v. Brass Rail Tavern, Inc. and McMahon v. Young. The cases stated that the test to be applied when qualifying an expert witness to testify is whether the witness has any reasonable pretension to specialized knowledge on the subject under investigation and whether the opinions he/she will be expressing can be stated with reasonable certainty.

Other court rulings affect standards through the formation of crimes and penal codes within the states. These crimes codes cover topics such as the definition of relevant and admissible evidence and what would exclude evidence from court (rules 401 through 403) and the frequency with which audits must be conducted (penal code 13892). Additionally, government Acts can affect the standards which develop. The Occupational Safety and Health Administration Act, OSHA, continues to influence safety standards within laboratories and hazardous work environments. This Act will be discussed in greater detail later in this document in a discussion of safety standards.

Professional Organizations

Scientists and supervisors join professional organization early on in their careers as membership provides guidance in terms of education, training, and experience required to perform the tasks of the field. Every professional organization is likely to have its own code of ethics which is typically embedded in the association's bylaws. These standards are therefore are incorporated into an agency's Level 1 quality assurance documentation. Any viable code of ethics describes which behaviors are considered ethical and which are not as well as a mechanism for the enforcement of these codes. The enforcement mechanism of the codes of ethics forms Level 2 documentation. This mechanism describes procedures for filing complaints, investigating issues, and coming to a resolution despite the fact that most organizations possess similar methods.

Accreditation and Certification Bodies

Expert forensic science organizations look to certification and accreditation bodies for guidance on professionalism and objective standards that help judge the quality of employee and supervisor work. Furthermore, certification demonstrates a laboratory's concern for commitment to quality. Certification bodies will specify a minimum level of knowledge, training, and experience required to become certified. These standards are stated in the application process as

is a mechanism for the withdrawal of certification from individuals who do not maintain consistent knowledge or engage in unethical conduct. Because of the ability to withdrawal certification based on conduct, certifying body typically has its own code of ethics. Therefore, Level 1 and Level 2 documents are inherent in a certifying body's structure often as bylaws and policies. Level 3 documents are also present as procedure manuals as it is required that candidates be knowledgeable with the generally accepted analytical and operational standards of a discipline.

ISO Guide 17025-2005, General Requirements for the Competence of Testing and Calibration Laboratories, is an international program on which many accreditation and certification standards are based. Therefore, accreditation bodies are the ultimate source of Level 1 and 2 standards for forensic science laboratories, off of which companies base their individual codes and policies. Widely known and respected certification bodies in the forensic science field include the Forensic Specialties Accreditation Board (FSAB) and the American Society of Crime Lab Directors (ASCLD).

Scientific Working Groups

The goal of scientific working groups is to improve discipline practices and to build consensus on varying matters within the community. Specifically these groups issue Level 2 quality assurance practices and Level 3 analytical and procedural documents. Many working groups have subcommittees dealing with terminology, quality, ethics, and education/training. The committees remaining active in a given year receive sponsoring from the FBI laboratory and the National Institute of Forensic Science.

Because of the funding from federal agencies, it is sometimes argued that these working groups do not reflect and accurate pool of membership in the forensic science community. The value of the work these groups produce has never been questioned, only the breadth of practitioners which create the work. To combat such arguments many groups submit their work to a broader peer review by the ASTM Committee E30 on Forensic Science. It has been proven that the best way to ensure widespread adoption of established guidelines is to bring them through the Committee because it ensures a peer-based consensus and consistency of formatting and terminology. The functions of these groups are so important, as the work product will be maintained as long as it remains relevant to forensic science practice, regardless of the status of the working group itself.

ASTM Committee E30 on Forensic Sciences

Among all the organizations which create standards, the ASTM Committee E30 on Forensic Sciences is the single one in the United States which meets the five requirements set forth by regulations on federal participation in the development and use of voluntary consensus standards. The five requirements are openness, balance of interest, due process, an appeals process, and consensus. The Committee was founded in 1970 by the American Academy of Forensic Sciences (AAFS) in concern that there was no way to determine whether information presented was accurate, reliable, or meaningful. They say standards as a way to address the problem but were

greeted with adversity when they found out the forensic community was hostile to the development of standards.

In 1989 E30 was threatened with termination and an organizational meeting was called which revealed that some of the sentiment against standardization had changed. Fire debris analysis served a significant private sector market at that time and became the first forensic discipline to standardize at the bench level. The first standards were therefore adopted from guidelines by the International Association of Arson Investigators (IAAI), using fire debris analysis as a template. What caused E30 to boom was the *Daubert* decision in 1993 and the resulting fear that courts would exclude evidence in criminal cases due to a lack of consistent findings. E30 now has subcommittees in criminalistics, questioned documents, digital evidence, and interdisciplinary forensic issues.

E30 follows a very particular methodology for standard development. At the beginning of its life, someone must recognize the need for a standard and gather a "task group" often derived from a particular standard working group. A member of the group will prepare a first draft that is then redesigned into a group draft. This group draft is sent to the appropriate subcommittee who undergoes a ballot vote on the standard. The voting members of the subcommittee can affirm, abstain, or neglect the standard. All negative votes must be accompanied with a reason and a description of proposed changes. The subcommittee must then either revise the document or negate a negative vote by a two-thirds majority and approval of the governing ASTM body. At this point the standard may progress to the main committee ballot where the voting process is repeated. Once passed, the standard is published in a volume that is given upon admittance to the organization and is available to the public. However, standards are required to undergo revalidation every 5 years, at which point the standard can fail and cease to have any force.

Despite beginning troubles, and some continued resistance to the idea of standard protocols, the success of the ASTM E30 Committee was recognized in 1999 by the Justice Department. As of today, E30 maintains more than fifty published standards and ten or more in development. ISO 17025 states that deviation from a standard method is permissible, but only as long as it is technically justified and documented.

Insurance Carriers

Insurance plays a large role in encouraging the development of standards as well as affecting those standards already developed. Insurance inspections both internal and external ensure that standards and methods developed in the quality assurance manual are actually being carried out in the manner depicted. Internal audits serve as a kind of check-up on employee and system performance and often effect what certifications will be required of employees in the following year. External audits ensure that the operations of the organization can be understood by a larger audience and evaluate the efficiency of the organization. However, because of the sensitive and technical nature of these organizations, external audits can only be carried out by a select few organizations. These organizations include the Bureau of State Audits, the Office of the Inspector General, and most recently the National Forensic Science Technology Center (NFSTC). The NFSTC was established by ASCLD purely for the purpose of evaluating other forensic organizations for efficiency, proficiency, and knowledge.

SAFETY STANDARDS

Safety standards have come to the forefront of standardization as many organizations even outside of the forensic discipline affect safety and health practices. In 1970 the OSHA Act was written to help prevent work-related injuries, illness, or death. The Act established an administration which, to this day, holds tremendous power in creating workplace health laws, fining and trying businesses which violate the health standards, and maintaining auditing agencies. The Act itself established Public Law 91-596 which states provisions for employee safety in businesses. Shortly after the organization's establishment various regulations were also set forth, the most influential of which within the forensic community was Regulation 29. The regulation displayed provisions for chemical hygiene plans which had existed largely as only a verbal account previously.

OSHA has come to help establish other laws and standards since its inception. In 1989 the Injury and Illness Prevention Program was started which laid out operation guidelines for hazards and accidents as well as documentation of safety training and communication. And in 1990 OSHA was involved in a trail which eventually established the California Corporate Criminal Liability Act adding section 387 to the penal code. This made it a criminal offense for any manager to knowingly conceal a danger posing a serious health risk to workers or for a failure to ensure the correction of unsafe practices or conditions. This Act also defines the results of negligence as property and equipment damage as well as human suffering.

A result of the above series of regulations was the development by laboratories of written protocols. The protocols included revision of standard lab practices, respirator protection, hazard communication programs, right to know information, and material safety data sheets (MSDS's). These revisions eventually amounted to the development of official safety manuals for each laboratory. This manual must be presented at the time of initial assignment to a new position and/ or after a new hazard is introduced into the environment. The manual consists of various sections which contain its own set of standards applicable to that section. The safety manual outlines criteria for standard operating procedures, exposure control strategies, proper chemical selection and control measures, information and training procedures, the location of any first aid materials, provisions for medical consultation and evaluation, and the identification of personnel responsible for the implementation and maintenance of the chemical hygiene plan.

Recognition of Hazards

The safety manual contains a large section listing the chemical and physical properties of every substance within the laboratory. This information is presented through the MSDS sheets and often incorporates a table of incompatible chemicals posted throughout the lab. Through the American Chemical Society (ACS) and OSHA, four levels of hazardous materials exist. Level D requires minimum protection due to no known hazards existing. This level would require gloves, safety goggles, and proper lab clothing only. Level C requires slight respiratory protection and some skin protection and is often found in investigative labs. In this level could be included biohazard materials, and items which require a fuming hood to work with. Level B requires the highest level of respiratory protection with a somewhat reduced level of skin protection and is used in operational or investigative labs. Level A requires the highest skin, eye, and respiratory

protection with a fully encapsulating body suit as a necessity. Very few agencies are prepared to handle this kind of situation and its operations largely revolves around clandestine methamphetamine and LSD labs.

Methods of Contamination Confinement

The safety manual of any laboratory, even a high school chemistry lab, will describe protocols for containing the chemicals within the lab to the area it occupies alone. Every lab has regulations such as the following: do not eat, drink, smoke or apply cosmetics within the vicinity of any chemicals, remove gloves when telephoning or accessing a computer, and develop a separate storage area for chemically treated items. These protocols are basic, but lay the foundation for further regulations. Divisional laboratories should maintain separate working spaces and limit access to the lab only to those personnel properly trained in that discipline. Furthermore, separate areas within the lab should be designated for work with biological or deceased materials vs. regular chemical processing of casework. Of some assistance in maintaining this separation would be to code writing implements in the lab to designate contaminated items. The proper protection and sterilization of workspace, disposable items, and clothing should also be maintained. These regulations help maintain the integrity of the items under investigation and assure certainty in chemical processing.

Labeling Containers

Along with maintaining separation between workspaces in the lab comes the proper labeling of chemical storage containers. Without proper labeling, the appropriate method of use and storage cannot be assumed as the identity of the chemical itself is in question. OSHA and other federal standards require that the chemical manufacturer, chemical identity, appropriate chemical warnings, a statement of hazards, precautionary measures, date of receipt and preparation, concentration of the substance, and initials of preparer all be on a label. Only permanent, non-water soluble marker should be used to create labels to give the best chance that the label will remain intact.

Labeling was made much easier when the adoption of the National Fire Protection Association's (NFPA) method of labeling was assimilated into the chemical industry. The labeling system consists of four squares which make up a larger diamond shape, each square designating a different hazard area according to location and color. The left square designates health hazards and is colored in blue. The top square designates flammability and is colored in red, which is especially valuable information for proper storage. The right square designates reactivity or instability and is colored yellow. Finally the bottom square designates special or other hazards not previously mentioned. This label minimizes the amount of additional information needing to be placed on the storage container.

The NFPA labeling system also places a numerical value in each of these squares indicating the seriousness or degree of attention that should be called to that particular hazard type. A rating of zero indicated that no special hazards exist and the chemical can be handled relatively safely. A value of one states that nuisance hazards are present which require some care, but standard firefighting procedures can be used and minimal no additional lab precautions need to be taken.

The presence of the number two indicates that the substance can be fought with standard procedures but hazards are present which require certain equipment or procedures to handle safely. A rating of three depicts that should the substance become agitated or volatile the fire and extraneous results can be fought using methods intended for hazardous situations only. The final rating of four indicates a chemical that is too dangerous to approach in a standard setting. Additional fire-fighting equipment and procedures would need to be taken when handling the substance and even small quantities are extremely hazardous. This labeling has become standard and has greatly helped companies comply with all governmental and private health and safety standards.

Standard Operating Procedures

Standard Operating Procedures (SOP's) are Level 3 documents in the quality assurance manual which lay out methods for each process that occurs within the facility. SOP's come about and evolve in a variety different ways, largely revolving around independent research and subsequent standardization of this research. This evolution of SOP's depends upon a few factors such as the influence of professional organizations, the technology available at the time, similar publications which affect research, and the history of the department the SOP is contained within. It is this last reason which causes the greatest variability in procedures followed as the "this is the way we've always done it" mentality is a difficult thing to break.

Individual SOP's will not be discussed here as they can vary slightly between companies, but it should be understood that all laboratories contain similar SOP's dealing with multiple topics. These topics include procedures for: logging evidence and maintaining chain of custody, packaging evidence, steps of chemical processing, steps for instrumental analysis, and court presentation. A detailed description must be provided for each technique or procedure, such that someone with no knowledge could read the procedure and be able to perform the task. The procedures should also include any other vital information such as a chain of command for questions and issues.

Performance Indicators of Forensic Labs

Standardization is also important in the way evaluations are performed. Efficient practices must be defined in a manner which evaluates businesses as whole as well as individual disciplines. These evaluations must be performed in a standardized manner for similar businesses, in this case forensic laboratories. The evaluation criteria are presented in the following questions: Are resources allocated properly? This question is answered by common size statements released by each lab, which is then compared to other labs of similar size. The second question is "Is lab performance efficient?" This question is answered through efficiency statements, audits, and ensuring the level 3 and 4 documentation in the quality assurance manual. "Would alternative practices result in improved services?" is answered by simply having vigilant employees which maintain certification and analytical procedures. The next two questions go hand in hand as both involve market development analysis and quality/risk management: "Are sufficient safeguards in place to assure quality" and "Is there adequate investment for equipment, training, and development?" The final question is the easiest to answer as it comes in a simple return on

investment statement. "Is the lab optimizing return on investment?" Standards provide companies with a means of evaluating all of this information.

WHY ARE STANDARDS SO IMPORTANT?

Forensic scientists resisted the idea of standardization of methods and practices for many reasons early in the history of the discipline. Arguments ranged from "every case is different" to "samples are too small and not homogenous." While these statements are true underlying principles of examination can apply to any case. Standards ensure that the profession is following a standard methodology and therefore produce a way of judging whether forensic results are meaningful, accurate and reliable in the context of the case. In fact, modern stakeholders have demanded that analysis be conducted in accredited laboratories by certified scientists. Moreover, expert witness testimony would mean little without these standards. Standard procedures allow an experts work to be evaluated by other scientists familiar with the procedure and therefore allow a jury to be convinced that the testing done was adequate to prove whatever statement of fact.

Standard practices, specifications, methodologies, and protocols allow businesses and organizations to conduct their work with all personnel having confidence in the validity, reliability, and meaning of the analyses involved. Forensic science communities have begun to accept that standardization is beneficial to the discipline. Standards will only branch out and evolve as time goes by. It is due to this fact that standards are beginning to become thought of not only as good practice but also as a duty to ourselves and to the scientific community.

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