Ashraf Mozayani
Carla Noziglia
Editors

The Forensic Laboratory Handbook Procedures and Practice

Second Edition

Humana Press

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Editors
Ashraf Mozayani
Harris County Institute of Forensic Science
Houston, TX
USA
Ashraf.mozayani@ifs.hctx.net

Carla Noziglia
Senior Forensic Advisor
Aiken, SC
USA
skipncar@aol.com

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Preface

It takes two for the truth – one to speak and another to hear
–Thoreau

Mention a forensic science laboratory and Abby of NCIS might spring to mind. Nice, but not exactly a reality. Perhaps you think of writers such as Sir Arthur Conan Doyle (closer) or Kathy Reichs (reality). Whatever your persuasion, forensic science is and has been interesting to the public for many years.

In this *Forensic Handbook*, 21 of the best of the best, the cream of the crop, the "Energizer bunnies of forensic science" (to quote Abby) have written of their specialties in the careers they love. These are real world heroes and heroines who fight crime not with a cape, but a lab coat.

Just as forensic science has become more in depth and broader in scope, so, too, has this second edition. This edition contains 21 chapters to the first edition's eight chapters, giving the reader a better insight into more uses of forensic science.

There are more issues in, more challenges to, and more applications of the principles of forensic science than ever before. The information gleaned from the testing of evidence yields much more information. The procedures, analytical instruments, and interpretation of results in forensic science require the scientists to have higher and broader levels of knowledge, skill sets to encompass the tiny micro to the vast macro levels of evidence, and a myriad of abilities both in the laboratory and in the courtroom. Thus, they who perform the testing must have more and more education and career-long continuing education. The practices have also reached into areas unheard of a mere ten years ago, such as anything digital. This has resulted in scrutiny of procedures, practices, laboratories, and people. Accreditation of laboratories and certification of scientists are now the accepted norm. From the first collection of evidence through analysis and interpretation to the final presentation to courts and other official bodies, ethics must be the guiding principle. The myriad legal issues of evidence and testimony are presented.

The well-appointed and well-equipped laboratories of today are a far cry from the closets (literally) where scientists were relegated. Safety procedures, contamination abatement, and ergonomic modules now allow the scientists to work in comfortable areas, with the latest in technology, following strict standards. Thus, one chapter discusses planning and design of a laboratory.

And not to forget the animal kingdom, the reader will learn how insects and bugs can assist in determining many things including a margin of time of death. You will read about the Fur, Fin, and Feather Lab, where scientists practice forensic protocols as applied to animals and their products.

In reading this handbook, you will find that, in many chapters, authors have discussed similar areas: accreditation, certification, ethics, the National Academy of Science report, and quality. These important facets of forensic science apply to varied disciplines.

No forensic handbook would be complete without the tried and true forensic disciplines: fingerprints, trace evidence, chemistry, biology, explosives and arson, forensic anthropology, forensic pathology, forensic documents, and firearms and toolmarks. However, even here, there are new and modern practices.

New to this edition are questions at the end of each chapter that can be used by the reader or, if used as a text, by the instructor. Also, at the end of each chapter is a brief biography of the author.

If these chapters tweak your interest, you will find information about educational requirements. To assist you, the Appendices contain resources such as national and international degree programs, forensic societies and websites, and granting organizations. With the advent of technology, old evidence has been tested successfully, and, indeed, the truth has set some free.

There is but one goal to which all of this progress is directed: truth. Enjoy your reading and may the truth be with you.

Houston, TX — Ashraf Mozayani
Aiken, SC — Carla Noziglia

Contents

Contributors

Carmine J. Artone
Supervisory Fingerprint Specialist, United States Secret Service (Retd.),
1157 Happy Ridge Drive, Front Royal, VA 22630, USA
cjartone@hotmail.com

Scott D. Batterman, PhD, PE
Batterman Engineering, LLC, 1415 Route 70 East, Suite 307, Cherry Hill, NJ 08034-2210, USA
scott@battermanengineering.com

Steven C. Batterman, PhD
Professor Emeritus, School of Engineering and Applied Science, School of Medicine, University of Pennsylvania, PA, USA; Batterman Engineering, LLC, 1415 Route 70 East, Suite 307, Cherry Hill, NJ 08034-2210, USA
batterman@aol.com

Robert Bianchi, BS
President, Bianchi Consulting, Ltd., 5502 Chestermill Court, Fairfax, VA, USA
RBConsulting700@aol.com

W. Jerry Chisum, BS
CA Department of Justice (ret'd), 4949 Broadway Sacramento, CA 95820, USA
wjchisum@comcast.net

Donnell Christian, BS
Director of Forensic Programs, Professional Business Solutions, Inc.,
1001 Boardwalk Springs Place, Suite 111, O'Fallon, MO 63368, USA
dchristian@epbsi.com

James B. Crippin, BS
Director, Western Forensic Law Enforcement Training Center,
33550 East Hwy 96, #334, Pueblo, CO 81001, USA
jbcrippin@msn.com

William M. Davis, PhD
Harris County Institute of Forensic Sciences, 1885 Old Spanish Train,
Houston, TX 77054, USA
William.davis@meo.hctx.net

Anja Einseln, BA, MEM
Training Manager, American Society of Crime Laboratory Directors, Laboratory Accreditation Board (ASCLD/LAB), 139 J Technology Drive Garner,
TX 27529, USA
anja@ascld-lab.org

Lisa Gefrides, MS, FABC
DNA Analyst I Harris County Medical Examiner's Office,
1885, Old Spanish Trail, Houston, TX 77054, USA
lisa.gefrides@meo.hctx.net

Ken Goddard, MS
Director, U.S. National Fish and Wildlife Forensics Laboratory,
Ashland, OR 97520, USA
ken_goddard@fws.gov

M. Lee Goff, PhD
Director, Forensic Sciences Program, Chaminade University, 3140 Waialae Avenue, Honolulu, HI 96816-1578, USA
lgoff@chaminade.edu

Michelle D. Hamilton, PhD
Assistant Professor, Forensic Anthropology Center at Texas State, Texas State University-San Marcos, 601 University Drive,
San Marcos, TX 78666, USA
michelle.hamilton@txstate.edu

Louis Hartman, PE, LEED, AP
Senior Mechanical Engineer, 26913 Northwestern Hwy,
Suitee 200, Southfield, MI 48033, USA
louh@crimelabdesign.com

Carol Henderson, JD
Director, National Clearinghouse for Science, Technology and the Law, Stetson University College of Law, 1401 61st Street South, Gulfport, FL 33707, USA
henderson@law.stetson.edu

Edward E. Hueske, MA
Forensic Training and Consulting, Criminalistics Program Coordinator,
University of North Texas, 1544 Valley Creek Road, Denton,
TX 76205, USA
xprtwit@aol.com

Simon Key
President Justice Trax, Inc., One West Main Street, Mesa, AZ 85201, USA
simon.key@justicetrax.com

Elizabeth A. Laposata, MD, FCAP, FASCP
Forensic Pathology and Legal Medicine, 245 Waterman Street, Suite 100,
Providence, RI 02906, USA
Laposata@BU.edu

William L. Leaver, BS, D-ABFDE
Forensic Document Examiner, Las Vegas Metropolitan Police Department (Ret'd),
19394 Highridge Way, Trabuco Canyon, CA 92679, USA
iamableaver@aol.com

Kurt W. Lenz, JD
Lecturer in Law University of Miami School of Law 1311 Miller Drive,
Room C418 Coral Gables, FL 33146
klenz@law.miami.edu

Helena Soomer Lincoln, DDS, PhD
Hospital Dentistry TC B1-208, University of Michigan Medical Center,
1500 E. Medical Ctr, Dr Ann Arbor, MI 48109-0018, USA
helena.soomer@gmail.com

Jennifer C. Love, PhD, D-ABFA
Director, Forensic Anthropology, Harris County Institute of Forensic Sciences,
1885 Old Spanish Trail, Houston, TX 77054, USA
jennifer.love@meo.hctx.net

Kenneth C. Mohr, Jr., BS
Senior Programmer/Planner, Crime Lab Design, 14 North Newstead,
Suite 200, St., Louis, MO 63108, USA
kenm@crimelabdesign.com

Ashraf Mozayani, PharmD, PhD, D-ABFT
Forensic Laboratory Director, Harris County Institute of Forensic Science,
1885 Old Spanish Trail, Houston, Texas 77054, USA
Ashraf.mozayani@ifs.hctx.net

Carla Noziglia
305 Ascot Drive, Aiken, SC 29803, USA
skipncar@aol.com

Mark Pollitt, MA
Associate Professor, Engineering Technology, Daytona State College Advanced
Technology, 1200 W. Int'l Speedway Blvd. Daytona Beach, FL 32114
pollitm@daytonastate.edu

William J. Tilstone, PhD
Quality Manager, Forensic Quality Services, Inc.,
13575 58th Street North, Suite 153,
Clearwater, FL 33760-3721, USA
billtils@mac.com

Katie Welch, MS, FABC
DNA Analyst I Harris County Medical Examiner's Office, Forensic Biology Laboratory, 1885, Old Spanish Trail, Houston, TX 77054, USA
skwelch17@sbcflobal.net

Chapter 1
Forensic Laboratory Accreditation

Anja Einseln, BA, MEM

Contents

1.1 Purpose of Accreditation

There are multiple reasons why a laboratory may elect to become accredited. One may be because it is mandated to become accredited. These mandates can include legislative, organizational, and in response to specific critiques received by the laboratory. Another reason may be that the laboratory director sees the intrinsic value accreditation provides to a laboratory's operations via a peer-review process

A. Einseln (✉)
Training Manager, American Society of Crime Laboratory Directors, Laboratory Accreditation Board (ASCLD/LAB), 139 J Technology Drive Garner, TX 27529, USA
e-mail: anja@ascld-lab.org

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as well as providing external recognition. A third possible reason to pursue accreditation may be the perceived requirement of work needing to be performed in an accredited forensic laboratory that occurs during the court qualification of a forensic expert. Regardless of the reason *why* a laboratory seeks accreditation, the true value of the accreditation process are the activities involved in developing a sound quality system and then being committed to continually improving the laboratory's practices and procedures. All of these activities are done to ensure the ongoing quality of work being performed in the laboratory.

When a person first hears the phrase "accreditation," several ideas may come to mind. A new forensic scientist may not seem deeply concerned or interested in accreditation, as "it's something management should take care of." There could also be inclusion or confusion with the concept of individual certification (see keywords). The primary focus of this chapter will be accreditation, but it is also important to recognize how accreditation and quality assurance are closely related, therefore the organizational acceptance of operational review and commitment to continuous improvement will impact both quality assurance and accreditation. One essential element of success will be commitment to the quality process. Without a solid foundation of structure and commitment to continuous improvement throughout the organization, the process is little more than empty gestures and a waste of time and resources.

1.2 Why Accreditation?

Laboratories that commit their management practices and organizational culture to quality practices will be rewarded with high-functioning personnel, reduced costs (after an initial time and effort investment in the process), quality work output, clear channels of communication (internally and externally), and an external recognition process that can be demonstrated to both stakeholders and parent organizations. While some may see quality control and accreditation as burdens of working in a forensic laboratory, the true benefit is often articulated best by former opponents of the process. As we move through this chapter, several examples will be provided to help demonstrate that when the process is embedded in a laboratory and then woven into the culture of our day-to-day practices, the result benefits all levels of the organization.

1.3 Employee Responsibilities

When you become an employee of a forensic laboratory, several things will be expected of you. First, you will need to become familiar with the practices of the laboratory. Some labs may call this their "quality system." These practices may include building security, access to operational areas of the lab, completion of training programs, operational instructions for analysis, directions regarding recording technical notes, annual proficiency testing, handling evidence, maintaining chain of custody, quality control steps during evidence examinations, and report writing

requirements. While this level of detail may be overwhelming at the beginning, the structure provided by these requirements will provide assurance of consistent practices and agreed upon methods of operation. Some of you may welcome the structure: "just tell me what to do, and I'll do it." Others may see the structure as restrictive and suppressing creativity. What is essential to be aware of is that the laboratory has defined its operations based upon the needs of the science and the stakeholders within the judicial system. I would ask you to reflect upon the idea of each person being allowed to maintain their own version of a chain of custody – would this be a quality practice? Would having a defined process where evidence is handled, tracked, and secured in a similar manner be seen as a burden by the justice community? The concept I would like for you to start considering is that defining boundaries of quality and then electing to accept them as part of the working environment is an essential part of your forensic science practice.

An example of resistance to structure can be provided by Jackie. Jackie sighs again as he looks up the initialing requirements for examinations records. "Why does this have to be so complicated?" he asks himself and his computer screen. After finding the requirement for initialing each dated entry in his notes, he applies his handwritten initials in pen to the fourth entry he made on the same page. "Why can't someone see that this is my handwriting?"

A few weeks later Jackie goes to trial and is asked to identify the notes he made in a particular case. When looking at the notes handed to him, he sees that John also had notes on this case, and John's handwriting is very similar to his own. After taking a moment to sort through all the forensic notes that attorney handed him, Jackie is able to sort out his own from John's and then proceed with his testimony. Remembering his previous thoughts of the "waste of time" associated with initialing his exam records, he is now very thankful that the lab had this procedure in place.

1.4 Quality System

Once a laboratory has gone through the process of documenting their operational practices, they may then elect to go through a process of accreditation. As you read previously, accreditation is a process of external review. In most states, within the United States, accreditation is voluntary. At the time of writing of this book, four states do have various versions of legislatively mandated accreditation: New York, Texas, Oklahoma, and Missouri. If you work in a forensic laboratory in one of these four states, you should make yourself aware of the specific legislation that will affect your forensic work. Someone new to the accreditation discussion may assume that forensic labs should all work identically and follow all of the same procedures. An important "larger picture" idea is to become aware of the operational variability of state governments, the law enforcement community, and judicial community and how this same variability is mirrored in the forensic community. You should be very careful in making assumptions about operational practices from one laboratory to the next. Each laboratory is a product of the needs of the community it serves, the parent organization, the judicial system, and the requestors of

forensic services. After becoming aware of this variability, you will begin to see why accreditation and the process of preparing a laboratory for accreditation allow each laboratory to develop its own quality system. In the United States, we have an individualistic approach to our lives and our work. With this type of culture, we are very hesitant to mandate or dictate uniformity in our lives. It seems to go against the grain of our cultural fabric. Other countries have a more pluralistic approach – where the benefit of the whole society outweighs the needs of the individual. This individualism lends itself to an innate perceived "right" to be able to choose our own way. This perceived "right" may occasionally get in the way of a successful accreditation effort. If I manage a forensic laboratory with fourteen employees, each wanting to do things their own way, and I do not define a quality system, I then have no process of ensuring quality and consistency. How do I know that the analysis done by one person is of equal quality when compared with the next person? By defining and then requiring the same practices within the laboratory, I can be assured of consistent quality of the results.

There is a fine line between rote analysis and enabling the creativity of the forensic practitioner. I would like to bring to mind the physician that you may go to for your routine care. When it comes to a cough or cold, a broken leg bone or appendicitis, having a consistent process for treatment is favored, because it has been validated and practiced, but allowing the doctor to make adjustments based on what they encounter during the procedure ensures quality of care. This same process can be seen when flying a commercial airliner from New York to Los Angeles. Although having procedures for take-off and landing, flight plans, and safety are excellent, having the variability of modifying the flight plan based on weather encountered or turbulence is a way of ensuring a safe and hopefully calm flight. An effective quality system will provide a structured environment, but will also have a mechanism to both adapt to variables and a way of modifying or improving procedures when necessary for the quality of the work.

Now you can begin to consider the process of continuous improvement. This whole idea ties back to accreditation via the process of "plan > do > check > act." This concept is one that can be found in the ISO website (www.iso.org), and serves as the foundation of all quality practices. Without feedback into the process, all the audits, assessment, reviews and checklist would amount to a volume of dead trees, rather than a treasure chest of opportunities to improve a laboratory's quality system and the practices within the laboratory.

The Internal Audit

Mike looks at his Blackberry and sees that Pam has sent another e-mail reminder about the audit that will begin tomorrow as well as a revised audit worksheet. He quickly looks at the attached audit form and then deletes the e-mail, because the worksheet he printed out three days ago looks almost identical, plus he already took notes on his printouts. He's sure the changes are minor and won't impact his work. He's so familiar with the quality requirements, he could do it without all these checklists Pam is constantly creating. She's still mad at him for not sitting through the three hour training meeting she held on Tuesday. She'll realize soon enough that he's a lot smarter than the other folks on the audit team.

Pam sees Mike walking into the conference room where the case files have been collected and stacked for each of her auditors. She sees Mike pulling out some worksheets. She's relieved that he seems to have prepared for this audit. She has some misgivings about asking him to be on the internal audit team, but he had worked for the state crime lab for twenty years and seemed to be a nice enough guy. After the first two hours of file review, Pam walks over to Mike to check on his progress. She takes a quick glance at the worksheet he's using and sees that he's missing a complete section of checklist items. "Mike, did you get my e-mail yesterday?" "Yes, Pam, I did." "Well, I see that your notes haven't recorded the three clause requirements I added in the latest version of the checklist." "What three clause requirements?" "Sections 5.6.3, 5.6.3.1, and 5.6.3.2 about the noting of photographs section." Mike sighs – he looks at the stack of case files he's already reviewed and remembers that each one of them had at least a few photos in each of them. "I'm sorry Pam. The checklist you sent last night looked so similar, I just used the one's I had already printed out." Pam looks at him, the files he's already completed and walks over to her section of the table to pick up some copies of corrected checklists. "No worries Mike. I had a chance to review the reports from last year's internal audit and recognized that this was an area that we didn't catch during our last round of internal audits. I realize now that I should have highlighted this in my e-mail, so I'll review the files you've already done." "Thanks Pam, but you shouldn't need to do that. I should have used the checklist you sent. The catch you made in last year's internal audit was an astute one. I don't think we would have noticed that in our section, and considering our next assessment will be next year, I'd rather be in a position where we catch it, rather than the assessment team." "Thanks Mike. Care to help me comb through our procedures for evidence handling next month to help fine tune that audit checklist? Your experience at the state lab may give us some good ideas for things to consider." "Sure Pam. Thanks for asking. I'll start reviewing through these files again so we can finish on time today."

1.5 The Process of Accreditation

1.5.1 The Choice

The first step in the process of accreditation would be the laboratory management, typically the laboratory director, making the active choice of pursuing accreditation. As mentioned previously, this may be mandatory or it may be elective. The next step would be to become familiar with the specific requirements of the accrediting body. This may require purchasing or acquiring copies of various accreditation manuals and documents, and then beginning an in-depth review of the steps required to make an application. If a laboratory is pursuing accreditation for the first time, adequate time and resources should be planned to address the scope of the application project. It is highly recommended that this process not be undertaken by only one person in a laboratory, as the quality system within a

laboratory affects many individuals. Ensuring sufficient time for planning, review, feedback, and modification will allow laboratory management to thoughtfully prepare and acclimate all personnel to the process of accreditation. By taking a single-person approach to the process of preparing a quality system and an accreditation application, opportunities for gaps and misconceptions creep in. One of the important parts of the on-site assessment is the review of staff and operations, and if only one person "has the answers" then it becomes clear that the laboratory is not functioning as one organization, but more of a one-person-show where everyone else is kept in the dark.

1.5.2 Applying

The application for accreditation will most likely require a laboratory to submit copies of all of its operational policies, procedures, manuals, and documents. This will give the assessment team an opportunity to prepare checklists for the on-site review. Documents that may be requested by the accrediting body may include, but are not limited to: laboratory quality manual, casework analysis procedures, training programs and competency testing practices, proficiency testing program, evidence handling procedures, laboratory security requirements, report writing and note taking procedures, testimony monitoring program, statements of qualification for all case working personnel, organizational charts, job descriptions, and calibration and maintenance procedures. The task of pulling together all of the application materials takes time, and a laboratory shouldn't try to slap things together and hope that they are buying some time until the team arrives at the laboratory. It will become very apparent to the person reviewing the application, and the team leader will typically have many years of experience when it comes to accreditation and quality assurance, and this will signal that the laboratory is not taking this process seriously. The laboratory should approach the process of finalizing and submitting an application as a major milestone in the accreditation process – this usually takes a few weeks or months, rather than hours. Once an application is completed, the laboratory management needs to focus on ensuring that the employees are prepared and that they are continuing to work in compliance with their laboratory quality system. Changes to the quality system should be avoided after making an application, as these changes would need to be communicated to the accreditation body for incorporation to the laboratory's application.

1.5.3 The Assessment Team

Once the application has been received and reviewed by the accreditation body, an assessment team will be organized by the accreditation body. The team size will be based on the size of the laboratory, the forensic disciplines that the laboratory offers services in, and the total number of case working staff in each discipline. A conversation

will take place between the assessment team leader and the laboratory designated point of contact (typically either the laboratory director or the laboratory quality manager) and part of that discussion will include identifying any gaps in the application package. If the gaps are major, the on-site assessment may not be scheduled until sufficient remediation and resubmission of materials is completed by the laboratory. A date for the on-site assessment will be negotiated between the assessment team leader and the laboratory point of contact. The number of days required for the on-site assessment will depend upon the number of case working staff, the number of and types of disciplines being accredited, and the number of laboratory locations under review. Some accrediting bodies may provide accreditation in a single discipline, where others may require the entire laboratory to undergo accreditation at the same time. A laboratory that is part of a state system of crime labs may be part of a larger assessment process, and therefore additional variables come into play from a planning perspective.

1.5.4 Assessment Team Preparation

After a date has been set and a team is assembled by the accrediting body, the team will begin its preparation for the on-site review. These activities can include: review of procedures, policies and forms, development of checklists and interview questions, review of training programs and records, and working with the team leader to prepare for any adjustments or modifications to the quality system. Again, it is highly recommended that no major changes be made to the laboratory quality system after the application is submitted to the accreditation body, because the assessment team will be preparing their checklists and notes based on the policies, procedures, and instructions that were submitted with the application. If any changes are made, they should be communicated the assessment team leader as soon as possible.

1.5.5 Laboratory Preparation

As the assessment team prepares itself, the laboratory management and personnel should also be preparing themselves. Becoming familiar with the planned daily assessment schedule and team logistics may help everyone understand the process and be prepared. Providing a meeting room and all requested records in one location is highly desirable. The time the team has on site is typically limited to regular working hours, so efficient use of time by all is a sound idea. Little details such as lunch and breaks, escort duties and security, transportation, and communication channels should all be sorted out early so that everyone can help out while the assessment team is on site. Most laboratories take an “all hands on deck” approach when the assessment team is on site, so everyone may be asked to help support the process. Communication processes should be defined for laboratory staff by the laboratory management. When a request is made by the assessment team (for example, requesting a particular record or to access a particular area), that

laboratory staff should know what the assessment team can access without prior management approval or notification, and what limitations or boundaries are in place to protect the laboratory work and evidence (for example, not providing security access codes to the assessment team). Another purpose for open channels of communication is so that the laboratory point of contact can be advised either before or soon after such a request is made so that they can monitor, participate, and maybe even anticipate the future needs of the assessment team. Clear channels of communication will help everyone during this process.

1.5.6 On-Site Assessment

The on-site assessment process can be both very interesting and stressful for all parties involved. The on-site process begins with an opening meeting where the assessment team is introduced to the laboratory. The laboratory director decides who may attend this meeting. Some laboratories may elect to have a very small opening meeting, and other choose to invite all of the laboratory staff. After the opening meeting, the assessment team will get to work. The first day may seem very quiet from the laboratory's perspective. Often times the first thing an assessment team will do is to review case files and quality records. Based on the information gleaned during this review, the assessment team members are better prepared to ask relevant and pertinent questions during staff interviews. Some assessment teams interview all of the laboratory staff, others may only interview a portion of the staff. You may be asked to demonstrate a procedure or asked to explain what you may do in a particular scenario. The best answer would be to know the requirements of your quality system and then follow the instructions. Trying to "wing it" or impress the assessor would not be appropriate. If you would normally look at the procedure, do this. If you need to look something up on a computer, or ask someone, do this. Part of the assessment process determine if you know where the laboratory instructions and procedures are, how to access them, how to find out if it is the current version you should be using for casework. The laboratory management is responsible for ensuring that you have the tools and support to do the work. Your job will be to know how to access and follow the requirements of the laboratory quality system. The assessment process is not a time for sniping or venting about management, unless you truly believe that it is affecting the quality of the work. Personality conflicts and infighting should not become part of the assessment process. Dealing with personnel matters is the responsibility of the laboratory management. The primary focus of the assessment process and accreditation is determining if the laboratory has a quality system that has been effectively implemented and maintained.

Whining, Sniveling Malcontent (also Known as WSM).

Malfoy sat down at his desk to review his index cards. He knew his interview was coming up next. He was going to share all of the injustices he's had to suffer since the new section supervisor was promoted. He'd show them. Malfoy walks into the

conference room to meet with Tracy and she invites him to sit at the head of the table. Well, at least she knows how smart he is. He has his Master's degree in forensic science and has been working cases diligently for the last 6 months. He had a few issues during training, but other than having to do his moot court twice, he was able to fly through the training program. The questions from Tracy seemed to focus on the training program and the case files she had reviewed. She asked some questions about the positive and negative controls that were run during analysis, but she never got around to asking his opinion about his supervisor. He started getting concerned that he wouldn't be able to share all of his issues with her. After answering one more question about security, he plunged forward with his complaints. Tracy listened to him as he talked for five minutes straight. She took a few notes, as she had been doing during the entire interview. After he finished, she thanked him for his time and he walked out of the conference room feeling pretty smug.

Tracy sat down with John, her team leader, and shared what had happened earlier with Malfoy. John shook his head and shared "Well, we seem to get one of them in every lab: someone who sees the assessment process as a time to tattle on their supervisor or coworker. I'm hoping that you listened to him for a short while and then tried to put an end to that line of discussion. Did you finish all of the interview questions?" "Yes, I did. He seemed to just need to vent about all of these personal concerns. None of them were related to the work in the lab, so I didn't have any concerns about the quality of the lab work. Should I say something to his supervisor?" "Oh, no, at least not directly. I'll mention to the quality manager this evening that we finished our interviews and see if any questions come up."

1.5.7 The Report

After the records have been reviewed, the reports read, the interviews completed, and the assessment report is prepared by the assessment team, the laboratory will be presented with the "findings" of the assessment team. Remember that the word "finding" should not be seen as negative, rather what the team "found" during the review. If the laboratory has been sincere in its preparation activities, they will find that they will have a high level of conformance with a large number if not a majority of the requirements. The focus will narrow in on the areas of non-conformance and the corrective actions that will need to take place in order for the laboratory to become accredited. It should be remembered that many of the requirements will have been met, therefore will not require remediation.

1.5.8 Corrective Actions

The next step in the accreditation process will be the laboratory addressing the corrective action items. Some of the corrective actions may be straightforward and require little time to complete. Other corrective actions may ask the laboratory

management to review operations or procedures and make modifications after receiving a better understanding of how to understand or apply a requirement. If a procedure is modified to address a corrective action, the assessment team may request a demonstration of compliance with the new procedure for a defined period of time (thirty, sixty or ninety days, depending on the type of modification). After the laboratory prepares the corrective action and the assessment team review and agrees that the corrective action is correct and appropriate, the corrective action can be closed. Once all the non-conformances have been addressed via the corrective action procedure, a decision to accredit the laboratory can be made. The accreditation decision is typically a formal presentation from the assessment team to the decision-making accreditation body recommending that the laboratory be accredited.

1.5.9 Accreditation Maintenance

Once a laboratory is accredited, the process does not end there. It must be recognized that there is a maintenance process associated with accreditation. This process can vary from accrediting body to accrediting body, but most include some type of self-monitoring, self-reporting, and annual review. Some may require surveillance visits or on-site reviews. Regardless of the monitoring activity, the main message is that accreditation should not be seen as a one-time project, but rather as a process of continuous improvement. To provide you with an example of a project, reflect on how you approached your academic career, there were certain classes you took, exams you had to complete, papers you had to write, and once you had completed all of these tasks, you received your degree, or, viewed another way, you reached the end of your project. In contrast to this example, consider process of working in an accredited laboratory similar to maintaining your car, from the perspective of continuous monitoring and improvement. When you purchased your car, it had some fuel in the tank, and it was clean and ran well. Being committed to the process of owning a car you will need to refuel the car, change the oil, buy new tires, have it periodically inspected, and provide repairs depending on usage, much in the same way that a laboratory needs to maintain its operations and be committed to the process of running a quality organization. The initial accreditation can be equated to that original car purchase, but there will be continual monitoring and improvements required based on the needs of the laboratory. Most often, we will not encounter major maintenance, but when we do, we diagnose the non-conformance and correct the situation. Monitoring of all aspect of the vehicle will ensure ongoing positive performance, but ignoring problems will only cause what may have been a minor issue at one time to blossom into a major trip to the repair shop. Having everyone become part of the success of a laboratory will ensure that when even the smallest thing is noticed, it becomes a chance to catch an issue before it becomes a major corrective action.

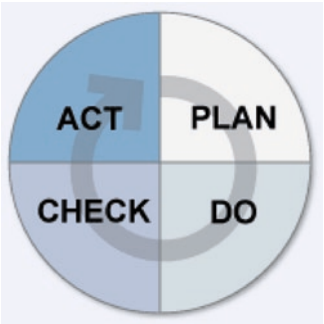

Fig. 1.1 Continuous Improvement Process

1.6 Continuous Improvement

As you have read during the course of this chapter, a laboratory must be committed to continuous improvement. The essence of this idea is captured in the four elements of Plan > Do > Check > Act.

1.6.1 Plan

The first element of this cycle is "plan." Plan can be identified as the activity taken by the laboratory management to develop its quality system. Planning or defining the policies, procedures, and instructions creates the foundation or structure in which all work needs to be done.

1.6.2 Do

The second element is "do." Do is defined as the activity done by the employees when they follow policies, procedures, and instructions. An assumption is often made that, if procedures are written, they will be followed. ISO sees these two activities as two separate steps that must be identified and be seen as elements of an effective quality system.

1.6.3 Check

The third element is "check." Check can be interpreted as either internal audits or external assessments. Incredibly important data is collected during this review activity. Having an effective audit will help a laboratory or any other organization successfully identify and then correct any possibly misinterpretations or defects in the quality system.