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## AN OVERVIEW OF UNITED STATES PHYSICIAN TRAINING, CERTIFICATION, AND CAREER PATHWAYS IN CLINICAL PATHOLOGY (LABORATORY MEDICINE)

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### **ABSTRACT**

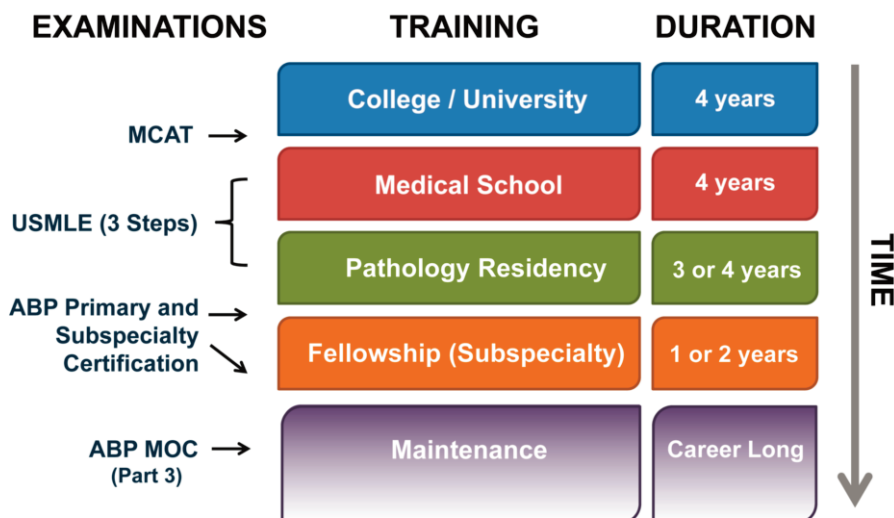
Clinical Pathology (CP) – also known as Laboratory Medicine - is a rewarding and yet under-recognized career option for United States (U.S.) and international medical school graduates. The present article outlines the training pathway toward becoming a clinical pathologist in the U.S, including undergraduate, graduate, and post-graduate phases of training. As the current state of CP residency training in the U.S. is the result of decades of curriculum reform, that progression is briefly reviewed to provide context for the shift toward competency-based education during residency and beyond. Options for fellowship training in CP subspecialties, as well as the current emphasis on Maintenance of Certification (MOC) and Maintenance of Licensure (MOL) are also discussed. This article concludes with a general overview of career pathways and options for those with CP training.

### **TERMINOLOGY**

In the U.S., completion of medical school is required before entering a pathology residency training program (Figure 1). The term “undergraduate” can have alternative meanings in U.S. education, so it is worth defining these for readers unfamiliar with this system. The term “undergraduate education” is commonly used across all academic disciplines to describe college / university education leading toward a bachelor’s degree (typically completed in four years) or associate’s degree (typically completed in two years). In the field of medicine, the similar term “undergraduate medical education” (UGME) refers to the four years of medical school completed after a college bachelor’s degree. Residency training is then referred to as “graduate medical education” (GME). Subsequent fellowship training and beyond is considered “post-graduate medical education”.

### **UNDERGRADUATE MEDICAL EDUCATION**

Requirements for admission to U.S. medical schools vary, but typically include a bachelor’s degree (or equivalent level of training) with specific coursework in biology, chemistry, physics, and English. Comprehensive information on this process is available through the American Association of Medical Colleges (AAMC) website (1). Applicants who do not complete this coursework



**Figure 1**  
 CP Training. Examinations, structure, and approximate training duration required to become a clinical pathologist and maintain certification in the U.S.

during their undergraduate education - but who subsequently decide to pursue a career in medicine – often enroll in post-baccalaureate programs to complete required coursework before applying to medical school.

A standardized, multiple choice examination taken by virtually all U.S. medical school applicants - the Medical College Admissions Test (MCAT®) - is used by medical schools as one factor in applicant evaluation and admission decisions. A centralized application service - the American Medical College Application Service (AMCAS®) – enables students to complete a primary application that is then submitted to more than one medical school (2).

Medical school admission in the U.S. is competitive. In 2012, for example, 45,266 students applied to U.S. medical schools, but only 19,517 matriculated (3). Applicants to combined M.D. / Ph.D. training programs are a much smaller group (2012 data: 1,853 applicants with 599 matriculants) (4). CP can be an attractive career option for M.D./Ph.D. trainees, as there is considerable synergy between the research skills obtained during graduate school and the scientific mindset that is useful in laboratory diagnostics and development (5).

The traditional medical school curriculum in the U.S. consists of two years of lecture-based coursework followed by two years of clinical rotations. Exposure to pathology in the undergraduate medical curricula occurs primarily in the pre-clinical years, with emphasis on histology and pathophysiology in lectures and course-based laboratories. Most medical schools offer students the option of completing a pathology rotation during the subsequent clinical years of training, although few schools require this training of all students. An introduction to laboratory testing and ordering practices has traditionally been emphasized during the clinical phases of training, and is often provided primarily by interns, residents, and medical attending physicians (as opposed to those with specialty training in CP). By this point, many medical students have already decided on their chosen career trajectory outside of pathology. A small number of medical schools, however, have developed specific electives and/or exposure programs to laboratory medicine for medical students (6). Case-based training methods used by some medical schools also enable an introduction of laboratory concepts earlier in pre-clinical training. An excellent review article focused on methods of incorporating and teaching the basic principles of laboratory medicine to medical students was recently published by Park and Marques in 2007 (7). A proposed curriculum designed to help medical schools enhance laboratory medicine education has also been developed by an ad hoc committee of the Academy of Clinical Laboratory Physicians and Scientists (ACLPS) (8). Resources such as these can serve as valuable tools during ongoing curriculum reform.

A major focus of the fourth year of medical school in the U.S. involves the application to (and interviewing for) subsequent residency training programs. Only a small minority of medical students decide upon a career in pathology. In 2012, approximately of 3% of applicants using the Electronic Residency Application Service (ERAS®) were applying for pathology residencies (9). Of these pathology applicants 46% were female (9). It should be noted that the vast majority (86%) of pathology residents pursue combined anatomic pathology / clinical pathology (AP/CP) training, while 11% are AP-only and 3% are CP-only trainees (10).

Along with completing specific medical school requirements, U.S. medical trainees also take the three-step United States Medical Licensing Examination (USMLE®), which is developed by the National Board of Medical Examiners (NBME®) (11). While requirements vary by state, successful completion of the USMLE is generally a requirement for licensure by state medical boards and therefore the practice of medicine (and pathology) by physicians. Information on additional training and certification requirements for international medical graduates is available through the Educational Commission for Foreign Medical Graduates (ECFMG®) (12).

## GRADUATE MEDICAL EDUCATION IN PATHOLOGY

The American Council for Graduate Medical Education (ACGME) is the primary organization which accredits U.S. residency training programs. In the 2012-2013 academic year there were 143 ACGME-accredited pathology residency programs, with a total of 2,391 on-duty pathology residents (13). The ACGME also accredits pathology fellowship programs (see POST-GRADUATE MEDICAL EDUCATION IN CLINICAL PATHOLOGY).

### Structure and Content of Residency Training

Combined AP/CP training involves completing a four year pathology residency program (14). AP-only or CP-only training can be completed in three years. Training requirements for pathology are the result of several decades of evaluation and revision by professional organizations interested in pathology education. As this history is relevant for understanding the current structure and curriculum requirements of pathology residency training, a brief review is provided below.

In 1985, the American Board of Pathology (ABP) added a credentialing year requirement to the traditional four year AP/CP or three year AP-only or CP-only certification (15). This additional year could be satisfied through several avenues, including subspecialty training, clinical experience, and/or research. Out of a desire to make AP/CP training more attractive to medical students, the Association of Pathology Chairs (APC) held a 1987 meeting in Park City, UT to make additional curriculum recommendations and define outcome expectations for pathology training (16). The final Park City report was released in 1988 and recommended that AP/CP residency should be comprised of five years of training, consisting of three years in the “major areas of Anatomic and Clinical Pathology” and two years of additional training in “(1) general anatomic and/or clinical pathology; (2) a subspecialty of pathology; (3) research; [or] (4) a clinical year of experience in internal medicine, pediatrics or another relevant clinical discipline.” (16) Furthermore, one of these additional two years could be applicable toward subspecialty certification (16, 17).

Due to the importance of the Park City report recommendations, the American Society for Clinical Pathology (ASCP) convened a meeting in 1989 (the first ASCP Colorado Springs Conference) with the participation of program directors, department chairs, and representatives from the College of American Pathologists (CAP) and the ACGME Residency Review Committee (RRC) among others (17). The purpose of this conference was to discuss the Park City report, its impact on pathology residency training, and ultimately to provide a written consensus statement. The Colorado Springs Conference supported the Park City recommendations and provided further analysis of its possible impact on policy, content of training, accreditation, certification, academic pathology, community practice, and recruitment (17).

A subsequent meeting, the 1993 ASCP Colorado Springs Conference IV (planned by the Conjoint Task Force of designees from APC, ACLPS, CAP, and ASCP) focused on improving CP training specifically, as there was growing concern that reforms were required to ensure the survival of the field (18). Specific emphasis was placed on graduated educational experiences (i.e. increased responsibility and expectations in subsequent years of training) and further curriculum reform. More detailed CP curriculum recommendations were made by the Conjoint Task Force in its influential Graylyn Conference Report in 1995, including proposed structure and content of the 18 months of CP residency training, competency characteristics, and outcomes expectations (19). The goal of these recommendations are just as relevant to pathology education today: “the creation of scientifically oriented clinical pathology practitioners capable of serving as consultants to other physicians, of managing laboratory resources, and of playing leadership roles in an increasingly complex health-care system” (19).

After considerable debate, the credentialing year requirement was dropped by ABP for residents who began their training in or after 2002, thus bringing the current structure of pathology residency training into place (15). Specific requirements for pathology board certification are available online on the ABP website in the Bulletin of Information (20). Requirements for primary board certification in CP include 36 months of training in an accredited program - 24 of these months must include “structured CP training” and a maximum of 6 months of research time may be included (20).

### Curriculum, Competency, and Training Outcomes

Defining the structural and procedural requirements for a training program is the first step in helping to consistently train capable pathologists, but it does not by definition ensure either the competence of an individual trainee nor the effectiveness of a given training program. The first decade of the 21st century was marked by a clear shift toward “competency-based residency training” in U.S. programs including pathology (21). For example, in 1999 the ACGME endorsed (across all accredited medical specialties) six general areas of competency in graduate medical education: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice (Table 1) (22). These competencies now permeate the domains of pathology education, board certification, licensure, maintenance of certification (MOC), and continuing medical education (CME). By 2006 (Phase II of the ACGME Outcome Project) these competencies were formally incorporated into laboratory medicine training (23). For example, ACGME patient care competencies that must be included in a program’s CP curricula include instruction in microbiology, immunopathology, transfusion medicine, chemical pathology (i.e. clinical chemistry), cytogenetics, hematology, coagulation, toxicology, medical microscopy, and other advanced

<b>Table 1</b> The Six ACGME Core Competencies)
Patient Care Medical Knowledge Practice Based Learning and Improvement Systems Based Practice Professionalism Interpersonal Skills and Communication

diagnostic techniques (14). Examples of the other five competencies are available in the ACGME Program Requirements (14). These ACGME core competencies are broad and do not actually define the precise content of training. Medical specialty organizations have taken the lead in defining what should be included in residency curricula. For example, the Association of Directors of Anatomic and Surgical Pathology (ADASP) released a proposed AP residency curriculum in 2003 (24). In 2005, ACLPS developed a proposed curriculum for CP training. The ACLPS proposal incorporates overall training goals of residency, competencies shared among all CP rotations, didactic methods, rotation schedules, inclusion of graduated responsibility, and topics to be covered during discipline-specific rotations (25). For those familiar with European training, there is some content overlap between many of the topics covered in the ACLPS proposed CP curriculum and the EC4 European syllabus for clinical chemistry and laboratory medicine (26, 27).

In the U.S. there is considerable variation in how residency programs design CP training, as each program may have differing organizational and laboratory structures, service responsibilities, patient populations, and faculty expertise. A helpful review of teaching methods useful for educating pathology residents in laboratory medicine was published in 2007 (28). That issue of Clinics in Laboratory Medicine also includes rotation-specific articles on chemistry (29), transfusion medicine (30), microbiology (31), point-of-care testing (32), and laboratory management (33). Additional proposed curricula for laboratory management (34) and resources for informatics training (35-37) have also recently been developed.

Even with a defined curriculum and a focus on innovative and/or effective teaching modalities, how can a program director effectively measure how well they are educating residents in CP? The ACGME institutional requirement of internal review, competency evaluation programs, periodic site visits, and monitoring of first time board certification pass rates can provide valuable information for assessing the adequacy of a program’s educational success (38, 39). Communication between program directors on the APC / Program Directors Section (PRODS) listserve is another way to gather valuable feedback and share educational strategies (40).

Another useful measure is the ASCP Resident In-Service Examination (RISE). RISE is taken annually by all U.S. pathology residents (and some international trainees) and can be used as a valuable tool for both resident self-assessment and program director evaluation of program effectiveness (41, 42). Senior resident RISE scores have even been shown to correlate with first attempt ABP certification exam pass rates (43).

A significant step toward monitoring educational outcomes during residency training is underway – the ACGME’s Next Accreditation System (NAS) Milestone Project (44). One goal of the Milestone Project is “to accelerate the ACGME’s movement toward accreditation on the basis of educational outcomes.” (45) These outcomes will be specialty-specific, based on progression of performance levels throughout residency, and are being developed “in a close collaboration among the ABMS certifying boards, the review committees, medical specialty organizations, program-director associations, and residents” (45). Pathology-specific milestones for AP and CP have been developed (46). The NAS will be implemented in phases, with a group of seven specialties beginning accreditation under this system in July 2013 with the rest (including pathology and pathology subspecialty fellowships) beginning in July 2014.

**POST-GRADUATE MEDICAL EDUCATION IN CLINICAL PATHOLOGY**

The CP curriculum creates a certain baseline education for trainees who may ultimately enter one of many different career trajectories (47). Preparation for subspecialty pathology careers in the U.S. usually involves fellowship training. In the 2012 ASCP Fellowship & Job Market survey, 95% of third- and fourth-year pathology residents taking RISE stated that they have either applied (or intend to apply) to fellowship programs (48). Of the 14 most preferred fellowships chosen by respondents, only a few (hematopathology, blood banking / transfusion medicine, molecular genetic pathology / molecular pathology) fall into a traditional CP (or AP/CP) categorization, emphasizing the predominance of AP career focus among pathology trainees.

ACGME accredits fellowships in a variety of CP-oriented subspecialties such as blood banking / transfusion\*, chemical pathology\*, hematology\*, medical microbiology\*, medical toxicology, medical biochemical genetics, and molecular genetic pathology\* (14) [\* indicates that subspecialty certification is through ABP]. ACGME is working to accredit fellowships in clinical informatics, and subspecialty certification will be provided through a joint function of ABP and the American Board of Preventative Medicine (ABPM) (49). Possible structure and curricula for clinical informatics fellowship training have been the focus of several recent publications (50, 51). Of all the ACGME-accredited CP-oriented subspecialties, chemical pathology has had the lowest enrollment,

with only one trainee enrolled nationally in the 2012-2013 academic year (52). It should be noted, however, that the subspecialty chemical pathology is similar to that of clinical chemistry, a field that has Ph.D.-predominant fellowship programs accredited by the Commission on Accreditation in Clinical Chemistry (ComACC) with certification offered through the American Board of Clinical Chemistry (ABCC). A list of pathology-related organizations (Table 2), as well as additional subspecialty and/or certification organizations (Table 3) is provided. Dr. Joely Straseski provides a detailed overview of postdoctoral fellowship programs in another article in this journal edition.

### MAINTENANCE OF CERTIFICATION (MOC) AND MAINTENANCE OF LICENSURE (MOL)

Regarding pathology board certification, all primary and secondary certifications issued by ABP on or after 2006 are “time-limited” and expire on December 31st 10 years after issuance (53). To receive a new certificate the diplomate must complete an ongoing Maintenance of Certification (MOC) program. The MOC process requirements involve demonstration of professional

<b>Table 2</b> Representative Organizations in U.S. Pathology Education.+,*		
Academy of Clinical Laboratory Physicians and Scientists	ACLPS	www.aclps.org
Accreditation Council for Graduate Medical Education (also, ACGME Residency Review Committee)	ACGME (RRC)	www.acgme.org
American Association of Medical Colleges	AAMC	www.aamc.org
American Board of Medical Specialties	AMBS	www.abms.org
American Board of Pathology	ABP	www.abpath.org
American Society for Clinical Pathology	ASCP	www.ascp.org
American Society for Investigative Pathology	ASIP	www.asip.org
Association of Directors of Anatomic and Surgical Pathology	ADASP	www.adasp.org
Association of Pathology Chairs	APC	www.apcprods.org
College of American Pathologists	CAP	www.cap.org
Federation of State Medical Boards	FSMB	www.fsmb.org
Intersociety Council for Pathology Information	ICPI	www.pathologytraining.org
US Canadian Academy of Pathology	USCAP	www.uscap.org
+ Websites accessed 28 Jan 2013		
* Additional, subspecialty, and/or certification organizations are listed in <b>Table 3</b> .		

<b>Table 3</b> Subspecialty and/or Certification Organizations+		
American Board of Clinical Chemistry	ABCC	www.abclinchem.org
American Board of Emergency Medicine (medical toxicology boards)	ABEM	www.abem.org
American Board of Medical Genetics	ABMG	www.abmg.org
American Board of Medical Laboratory Immunology	ABMLI	www.microbiologycert.org/abmli.asp
American Board of Medical Microbiology	ABMM	www.asm.org/index.php/professional-certification/abmm
American Board of Pathology	ABP	www.abpath.org
American College of Medical Toxicology	ACMT	www.acmt.net
American College of Microbiology	ACM	www.microbiologycert.org
American Medical Informatics Association	AMIA	www.amia.org
American Society for Microbiology, Committee on Postgraduate Educational Programs	ASM-CPEP	www.asm.org/index.php/postgraduate-training-cpep
Association for Molecular Pathology	AMP	www.amp.org
Association for Pathology Informatics	API	www.pathologyinformatics.org
Commission on Accreditation in Clinical Chemistry	ComACC	www.comacc.org
+ Websites accessed 28 Jan 2013.		

standing, life-long learning and self-assessment, cognitive expertise, and evaluation of performance in practice (54). The MOC concept has been adopted by all members of the American Board of Medical Specialties (ABMS) (55). For ABP, certain components are due on two-, four-, and ten-year intervals as specified in the MOC Booklet of Information and a recent review article on this topic (53, 54). One component of note in the MOC process is the “Part 3: Cognitive Expertise” requirement, which will involve a written examination to be taken between year 8 and 10 of every MOC cycle. Logistics and content of the examination, however, are still under development. The first year it will be offered to eligible diplomates is 2014 (54). It should be noted that the Federation of State Medical Boards (FSMB) has also endorsed the implementation of a Maintenance of Licensure (MOL) process for state medical licenses (56, 57). It is likely that adherence to a specialty board’s MOC process will meet the requirements in future MOL initiatives. One consequence of MOL, however, might be that even those who were “grandfathered” out of the ABP MOC process (by receiving their certifications before 2006) may one day find themselves required to participate in MOC and/or MOL to maintain the status of their state medical license.

### CAREER PROSPECTS IN CP

Given the relatively low number of medical graduates who enter pathology and the growing reliance on laboratory data for clinical decision making and patient management, career prospects for physicians in CP specialties remain strong, although the initial job market can be competitive. The ASCP Fellowship & Job Market Survey provides useful information on the recent experiences of residents and fellows in finding employment, pursuing additional training, and annual starting salaries (48). Additional comparative salary information is also available from AAMC (58).

In their careers, clinical pathologists have significant direct and indirect impacts on patient care. Laboratory data is critical in diagnosing disease and guiding effective patient management. Through activities such as clinical consultation, test interpretation and/or sign-out, assay development, laboratory directorship responsibility, and leading quality improvement initiatives, clinical pathologists serve as valuable members of the broader clinical team. Graduates with subspecialty training may work either primarily within their area of expertise or sometimes with directorship roles over a variety of laboratories in support of their institution/employer’s clinical needs.

Career opportunities in CP are certainly not limited to clinical, private practice, and/or hospital settings. Medical directorship roles are also available in public health laboratories as well as regulatory agencies in city, state, and federal capacities. Clinical pathologists (and trainees) can also become involved in global health initiatives and outreach operations. Some pursue jobs in the laboratory diagnostics industry or in reference laboratory settings. There is no “set course” for careers in CP, but rather a multitude of options guided by subspecialty training, personal goals, and job opportunities. CP is an exciting field of medicine and one that more medical school trainees should consider.

### References

1. American Association of Medical Colleges (AAMC). Website. Accessed on 23 Jan 2013. [www.aamc.org/students/applying](http://www.aamc.org/students/applying)
2. American Medical College Application Service (AMCAS). American Association of Medical Colleges. Website. Accessed on 24 Jan 2013. [www.aamc.org/students/applying/amcas/](http://www.aamc.org/students/applying/amcas/)
3. U.S. medical school applications and matriculants by school, state of legal residence, and sex (2012). Table 1. American Association of Medical Colleges. Website. Accessed on 21 Jan 2013. [www.aamc.org/data/facts/](http://www.aamc.org/data/facts/)
4. MD-PhD applicants, acceptees, matriculants, and graduates of U.S. medical schools by sex (2001-2012). Table 32. American Association of Medical Colleges. Website. Accessed on 21 Jan 2013. [www.aamc.org/data/facts/](http://www.aamc.org/data/facts/)
5. Santoro, S.A., C.A. Mosse and P.P. Young, The MD/PhD pathway to a career in laboratory medicine. *Clin Lab Med*, 2007. 27(2): p. 425-34.
6. Molinaro, R.J., et al., Teaching laboratory medicine to medical students: implementation and evaluation. *Arch Pathol Lab Med*, 2012. 136(11): p. 1423-9.
7. Park, Y.A. and M.B. Marques, Teaching medical students basic principles of laboratory medicine. *Clin Lab Med*, 2007. 27(2): p. 411-24.
8. Smith, B.R., et al., Educating medical students in laboratory medicine: a proposed curriculum. *Am J Clin Pathol*, 2010. 133(4): p. 533-42.
9. Residency Applicants by Specialty and Sex (2012). Table 38. American Association of Medical Colleges. Website. Accessed on 21 Jan 2013. [www.aamc.org/data/facts/](http://www.aamc.org/data/facts/)
10. Bollinger, T.J., 2008 ASCP Resident Council Fellowship & Job Market Survey. American Society for Clinical Pathology. 2008, Chicago, IL.
11. United States Medical Licensing Examination. Website. Accessed on 21 Jan 2013. [www.usmle.org](http://www.usmle.org)
12. Educational Commission for Foreign Medical Graduates. Website. Accessed on 22 Jan 2013. [www.ecfmg.org](http://www.ecfmg.org)
13. Number of Accredited Programs by Academic Year. American Council for Graduate Medical Education - Public Data. Website. Accessed on 22 Jan 2013. [www.acgme.org/ads/public](http://www.acgme.org/ads/public)
14. ACGME Program Requirements for Graduate Medical Education in Anatomic Pathology and Clinical Pathology (2007). Website. Accessed on 26 Jan 2013. [www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/300pathology\\_07012007.pdf](http://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/300pathology_07012007.pdf)
15. Bennett, B.D., Certification from the American Board of Pathology: getting it and keeping it. *Hum Pathol*, 2006. 37(8): p. 978-81.
16. Park City Report on Combined AP/CP Residency Training. Association of Pathology Chairmen. Graduate Medical Education Committee. 1988, Bethesda, MD.
17. Burke, M.D., et al., Special report: ASCP Colorado Springs conference. The future content and structure of residency training in pathology. *Am*

- J Clin Pathol, 1990. 93(5): p. 706-11.
18. Burke, M.D., J.M. Nuzzo and R.W. Prichard, ASCP Colorado Springs Conference IV: Clinical pathology residency. Curriculum reform. Am J Clin Pathol, 1993. 100(4 Suppl 1): p. S7-14.
  19. Graylyn Conference Report. Recommendations for reform of clinical pathology residency training. Conjoint Task Force of Clinical Pathology Residency Training Writing Committee. Am J Clin Pathol, 1995. 103(2): p. 127-9.
  20. Requirements for Primary Certification. The American Board of Pathology. Website. Accessed on 16 Jan 2013. [www.abpath.org](http://www.abpath.org)
  21. Folberg, R., D.A. Antonioli and C.B. Alexander, Competency-based residency training in pathology: challenges and opportunities. Hum Pathol, 2002. 33(1): p. 3-6.
  22. Leach, D.C., Evaluation of competency: an ACGME perspective. Accreditation Council for Graduate Medical Education. Am J Phys Med Rehabil, 2000. 79(5): p. 487-9.
  23. Alexander, C.B., Assessing resident competency in laboratory medicine. Clin Lab Med, 2007. 27(2): p. 269-81.
  24. Association of Directors of, A. and P. Surgical, Curriculum content and evaluation of resident competency in anatomic pathology. A proposal. Am J Clin Pathol, 2003. 120(5): p. 652-60.
  25. Smith, B.R., et al., Curriculum content and evaluation of resident competency in clinical pathology (laboratory medicine): a proposal. Clin Chem, 2006. 52(6): p. 917-49.
  26. Beastall, G., et al., A guide to defining the competence required of a consultant in clinical chemistry and laboratory medicine. Clin Chem Lab Med, 2005. 43(6): p. 654-9.
  27. Zerah, S., et al., EC4 European Syllabus for Post-Graduate Training in Clinical Chemistry and Laboratory Medicine: version 3 - 2005. Clin Chem Lab Med, 2006. 44(1): p. 110-20.
  28. Rinder, H.M. and B.R. Smith, Innovative methods in laboratory medicine resident teaching. Clin Lab Med, 2007. 27(2): p. 255-67.
  29. Genzen, J.R. and M.D. Krasowski, Resident training in clinical chemistry. Clin Lab Med, 2007. 27(2): p. 343-58.
  30. Wu, Y., C. Tormey and G. Stack, Resident and fellow training in transfusion medicine. Clin Lab Med, 2007. 27(2): p. 293-342.
  31. Haller, B.L., Resident training in microbiology. Clin Lab Med, 2007. 27(2): p. 369-80.
  32. Campbell, S. and P.J. Howanitz, Resident training in point-of-care testing. Clin Lab Med, 2007. 27(2): p. 397-410.
  33. Weiss, R.L., Training in laboratory management and the MBA/MD in laboratory medicine. Clin Lab Med, 2007. 27(2): p. 381-95.
  34. Weiss, R.L., et al., A consensus curriculum for laboratory management training for pathology residents. Am J Clin Pathol, 2011. 136(5): p. 671-8.
  35. Kang, H.P., et al., Residency training in pathology informatics: a virtual rotation solution. Am J Clin Pathol, 2009. 132(3): p. 404-8.
  36. Kim, J.Y., et al., The pathology informatics curriculum wiki: Harnessing the power of user-generated content. J Pathol Inform, 2010. 1: p. 10.
  37. Park, S., et al., Use of a wiki as an interactive teaching tool in pathology residency education: Experience with a genomics, research, and informatics in pathology course. J Pathol Inform, 2012. 3: p. 32.
  38. Davey, D., Review committee use of board certification results. RRC News for Pathology, 2012. March: p. 3.
  39. ACGME Institutional Requirements (2007). Website. Accessed on 18 Jan 2013. [www.acgme.org/acgmeweb/Portals/0/irc\\_IRCpr07012007.pdf](http://www.acgme.org/acgmeweb/Portals/0/irc_IRCpr07012007.pdf)
  40. Association of Pathology Chairs / Program Directors Section (PRODS). Website. Accessed on 25 Jan 2013. <http://www.apcprods.org/PRODS/>
  41. American Society for Clinical Pathology - Resident In-Service Examination (RISE). Website. Accessed on 25 Jan 2013. [www.ascp.org/rise](http://www.ascp.org/rise)
  42. McKenna, B.J., The American Society for Clinical Pathology resident in-service examination: does resident performance provide insight into the effectiveness of clinical pathology education? Clin Lab Med, 2007. 27(2): p. 283-91.
  43. Rinder, H.M., et al., Senior pathology resident in-service examination scores correlate with outcomes of the American Board of Pathology certifying examinations. Am J Clin Pathol, 2011. 136(4): p. 499-506.
  44. The next accreditation system. Accreditation Council for Graduate Medical Education (ACGME). Website. Accessed on 22 Jan 2013. [www.acgme-nas.org](http://www.acgme-nas.org)
  45. Nasca, T.J., et al., The next GME accreditation system--rationale and benefits. N Engl J Med, 2012. 366(11): p. 1051-6.
  46. Naritoku, W.Y., Pathology milestones are under construction. RRC News for Pathology, 2012. March: p. 2.
  47. Smith, B.R., Meeting the curriculum needs for different career paths in Laboratory Medicine. Clin Chim Acta, 2008. 393(1): p. 5-8.
  48. Rinder, H.M. and J. Wagner, ASCP Fellowship & Job Market Survey: A Report on the 2012 RISE, FISE, FISHE, NPISE, PISE and TMISE Surveys. American Society for Clinical Pathology. 2012, Chicago, IL.
  49. Requirements for Subspecialty Certification. The American Board of Pathology. Website. Accessed on 14 Jan 2013. [www.abpath.org](http://www.abpath.org)
  50. Levy, B.P., et al., Different tracks for pathology informatics fellowship training: Experiences of and input from trainees in a large multisite fellowship program. J Pathol Inform, 2012. 3: p. 30.
  51. McClintock, D.S., et al., A core curriculum for clinical fellowship training in pathology informatics. J Pathol Inform, 2012. 3: p. 31.
  52. Number of Accredited Programs for the Current Academic Year (2012-2013). American Council for Graduate Medical Education - Public Data. Website. Accessed on 22 Jan 2013. [www.acgme.org/ads/public](http://www.acgme.org/ads/public)
  53. Bennett, B.D. and M.M. Grimes, Certification and maintenance of certification: updates from the American Board of Pathology. Hum Pathol, 2011. 42(6): p. 770-3.
  54. Maintenance of Certification. Booklet of Information. American Board of Pathology (2012).
  55. Maintenance of Certification. American Board of Medical Specialties. Website. Accessed on 26 Jan 2013. [www.abms.org/maintenance\\_of\\_certification/](http://www.abms.org/maintenance_of_certification/)
  56. Inglehart, J.K. and R.B. Baron, Ensuring Physicians' Competence - Is Maintenance of Certification the Answer? NEJM, 2012. 367(26): p. 2543-2549.
  57. Maintenance of Licensure (MOL) Information Center. Federation of State Medical Boards. Website. Accessed on 26 Jan 2013. [www.fsmb.org/mol.htm](http://www.fsmb.org/mol.htm)
  58. Report on Medical School Faculty Salaries (2011-2012). American Association of Medical Colleges. 2013, Washington, DC.