Developing a comprehensive and robust curriculum for residency programs in clinical pathology (CP; also known as laboratory medicine) has been a goal for residency program directors for many years. Although there are many excellent training programs in CP, it is well recognized by faculty and residents that CP training is usually the weakest area of most combined training programs. The proposal by Smith and colleagues on behalf of the Academy of Clinical Laboratory Physicians and Scientists (ACLPS) addresses some of the major reforms needed to upgrade training in Clinical Pathology (1). Although this proposal attempts to be an all-encompassing roadmap to train clinical pathologists in the 21st century, many issues are still apparent that we would like to address here.

The ACLPS proposal is an extensive and detailed document. It is not practical to address the fine details of the proposal; rather, we would like to discuss several issues at the mile-high level. First, what defines a clinical pathologist? The answer to this question provides the foundation for defining residency training goals. Second, what, at a minimum, should be included in the CP residency curriculum? Finally, how should knowledge and technical competence be evaluated as part of a CP residency?

**What Defines a Clinical Pathologist?**
One can argue whether clinical pathologists are “clinicians, first and foremost” as promoted by the ACLPS proposal. Clearly, one major role for the clinical pathologist is to serve as a consultant to physicians and other healthcare providers in other medical specialties. Of course, a clinical pathologist should have considerable knowledge of medicine, but in our view, the primary expertise and focus of CP residency training should be on clinical laboratory testing and its integration into the practice of medicine. Clinical pathologists can have direct patient interactions in some disciplines of CP, such as supervising therapeutic apheresis and, increasingly at some institutions, providing cellular therapeutics. However, even in these settings, clinical pathologists function as specialists performing procedures. Rather than having primary responsibility for the medical management of patients, clinical pathologists serve a different yet critical role in patient care. A clinical pathologist is an expert on clinical laboratory testing and a consultant to the clinician.

On the basis of the above considerations, the ACLPS proposal [Table 2 in Ref. (1)], and the Graylyn Conference recommendations (2), a clinical pathologist should, in our view, achieve competence in 4 key areas:

1. Selection and interpretation of appropriate laboratory tests in clinical screening, diagnosis, and monitoring;
2. Evaluation, implementation, validation, and continued quality assurance of clinical laboratory tests and instruments;
3. Organization, staffing, and management of the clinical laboratory, including training of personnel, proficiency testing, and regulatory compliance;
4. Communication of laboratory findings to promote superior healthcare delivery, including participation in clinical conferences, serving as a consultant to clinicians, and keeping abreast of advancements in information management.

**Minimum Requirements for the Curriculum**
Requirements for the CP curriculum, as outlined in the ACLPS proposal, are context dependent. They depend on the career track and choice of subspecialty; they also depend, to a large extent, on local expertise at the training institution. From the standpoint of credentialing, it seems...
reason to consider first what the minimum level of competence should be across all residency training programs regardless of career goals for the individual trainee.

Achieving the knowledge and skill sets outlined in the ACLPS proposal during a CP or AP/CP residency seems overly ambitious and unattainable for many existing programs. Rather, we suggest setting goals that can be achieved by most programs, small and large, during the short period of CP or anatomic pathology (AP)/CP training. Well-trained pathologists do achieve many or most of the skills described in the proposal, but they would typically do so after more years of training. In this connection, it should be noted that only a small percentage of residency trainees enter private or community practice immediately after residency, according to the American Medical Association FREIDA (Fellowship and Residency Electronic Interactive Database) Database for Anatomic and Clinical Pathology (3). Rather, most trainees pursue additional training after residency (3). Although a strong curriculum is needed to ready some trainees for immediate entry into practice, considerable additional training beyond residency will be required to become expert in the various CP disciplines.

In an effort to provide a series of graded activities with increasing skill and responsibility, Smith and colleagues (1) provide 2 skill levels (I and II). Although this is a laudable goal, grading skill levels by seniority in the residency is inherently problematic. CP residency is short to begin with, and residency programs often divide training into blocks. Furthermore, some skill levels seem to overlap in content (for example, pharmacokinetics I and clinical enzyme kinetics II). Perhaps it would be more useful to stratify skill levels between residents and fellows.

A significant challenge lies in defining curricular training requirements. In their proposal, Smith and colleagues (1) outline the curriculum in broad strokes (for example, “understand hematopoiesis”). It now falls to the subspecialties within CP to clarify this. Another important component of residency training is career development. As in any medical specialty, faculty in CP serve not only as role models, but also as mentors to residents.

**Evaluation of Competency**

There are, in addition to medical, scientific, and technical knowledge, skills that derive from the application of this knowledge. Although the former can be evaluated by the use of standardized tests such as the resident in-service examination, the latter are more difficult to assess objectively. We believe that it is worth giving the following areas of competency explicit treatment in the CP curriculum: bench skills, data analysis, problem solving, communication, consultation, and laboratory management. As most of these areas of competency have been described in the ACLPS proposal, we will focus on 2 that we think are most worthy of further comment.

There are few examples in the ACLPS proposal that actually require hands-on competency for clinical pathologists. Rather, the vast majority of the curriculum focuses on “understanding” various concepts. How much of the curriculum should consist of residents actually performing laboratory tests? Each subspecialty within CP should define certain skills that could be deemed essential to a clinical pathologist’s training. Examples include achieving expertise in Gram stain evaluation and interpretation, preparation of a blood smear, and performing differentials, including identification of abnormal cells, amplification of DNA by PCR, performance of an ELISA, fluorescence microscopy, and so forth. It is difficult to serve as a consultant unless you are thoroughly familiar with the technical aspects of tests. Unfortunately, CP training has become less of a hands-on experience and more observational, relying on limited interactions with medical technologists to understand the real technical details of laboratory testing. Considering that 75% of pathologists practice in the community-hospital setting, most pathologists are very adept in AP (4). In CP, however, there is sometimes an overreliance on supervisors or senior staff to run laboratory operations. This shortcoming can be remedied in part by insisting on substantial competencies, gained by hands-on experience at the bench.

A second area of competency worth further comment is data analysis. In a broad sense, test interpretation falls under this category, but it is not clear from the current curriculum how “active” this type of learning would be. Ideally, residents in every CP subspecialty rotation would participate directly in the analysis of the raw data and would sign out their interpretation of those data with faculty supervision. In addition, as Smith and colleagues (1) aptly point out, there are specialized data interpretation skills (for example, analysis of flow cytometry data in hematopathology or Bayesian calculations in genetics) that need to be incorporated into a training curriculum. In some cases it may not be possible for residents to master these skills without additional training. There are also basic mathematical and statistical skills associated with data interpretation that residents should master by doing.

If one takes these areas of competency and melds them with the 4 key areas defined above, a list of core competencies can be compiled that includes the following: medical knowledge, scientific knowledge, technical knowledge, bench skills, data analysis, communication, clinical consultation, and laboratory management.

Rather than trying to force these competencies into the clinician-driven rubric of the Accreditation Council for Graduate Medical Education (ACGME) evaluation form, focusing on the above 8 skills will, in our opinion, provide a more balanced and accurate view of what a clinical pathologist should be learning during residency.

We thank Drs. Brad Johnson, Robert F. Thomas, Jr., and Malek Kamoun for helpful discussions. Drs. Luning Prak, Yu, and Nachamkin are Co-Directors of the Pathology...
We welcome the dialog entered into by Luning Prak et al. concerning the proposed clinical pathology/laboratory medicine (CP/LM)3 curriculum (1). Indeed, generation of discussion in this area was one of the major motivating forces that led to creation of that document. The CP/LM curriculum was deliberately designed as a template and not a blueprint, and as such, it is intended to be adapted to the philosophies and capabilities of the various extant programs. However, even with that open approach, we feel that we need to clarify and reemphasize aspects of the curriculum that are raised by Luning Prak et al.

First, the entire committee, comprising faculty members from over a dozen programs, felt strongly that we are educating clinicians to act as clinicians. This should not be viewed as meaning that there must be direct, face-to-face patient contact as the primary activity of the clinical pathologist, but rather that the clinical pathologist’s role is to treat the human condition of disease and health, albeit most frequently from a population-based orientation. Most often this clinical service will be provided within the “system-context” of the entire healthcare team, which includes direct patient-oriented clinical colleagues. (Although in some circumstances care may also be delivered directly to the patient by the clinical pathologist.) To function effectively in this role, the clinical pathologist must be competent in leading the operation of the laboratory in all of the critical aspects enumerated in the proposed curriculum (1). We fear that Luning Prak et al. have misunderstood this point, leading to a seeming disagreement with the emphasis of training that we do not believe is present in the curriculum document.

Second, there appears to be a philosophical schism that is suggested based on the construction of the particular curriculum. The committee that developed the proposed curriculum had extensive discussions as to whether it should reflect current capabilities of programs or be designed to capture what is generally felt to be core knowledge and skill sets. We chose the latter, whereas Luning Prak et al. appear to argue for the former. It is to be expected that not all programs can provide the entire training set, and not all residents may have an anticipated career path that will allow them to focus on all areas sufficiently to acquire the full knowledge and skill sets. Thus, programs and individuals will need to make adjustments or decide not to provide/acquire specific subsets of this training. Although such a choice may be viewed as lamentable, the proposed goal-oriented education will better ensure competency and excellence than would an adaptive curriculum based on the lowest common denominator.

Indeed, several of us have argued that the actual implementation of both anatomic pathology (AP) and CP curricula will need to consider the changing face of pathology practice as well as the realities of training. Some believe that the aims of an initial pathology training
period may need to be adjusted downward from the current lofty goal of truly comprehensive competency to practice in all areas of pathology in all settings. Such an adjustment has been the subject of action in other medical disciplines as the knowledge base explodes, and may need to be carefully examined in our discipline as well. Nevertheless, in the curriculum proposal (1), we believe that it is important to define what such global competency in CP truly involves.

We fully recognize that most residents enter so-called “community-based” service environments. Although the complexity of clinical laboratory testing is reduced in such settings, the actual practice of CP might be even more challenging, given the breadth and pace of advancements. As such, limiting the base training would be counterproductive to clinical practice. Rather, a pathologist entering such an environment may choose to attain competency in a subset of CP subdisciplines, as suggested in the proposed curriculum (1). This is increasingly possible in practice, as the average size of community-based practices is now 8 pathologists and growing. This, and the increasing availability of CP specialist consultations, allows for focused and deeper consultative competencies. In short, the days of a lone pathologist running all AP and CP services are limited by the increasingly broad and detailed nature of medical practice and by the actual ongoing changes in pathology services that this fact has engendered. The committee decided that we need to teach for the future and not for the present and the past.

A minor point appears to be a simplification of the concepts of gradated responsibility and educational reinforcement embodied in what are labeled levels I and II of our curriculum. Criteria for progression from one to the other, and incorporation of the appropriate knowledge and skill subsets (some of which are almost arbitrary in sequencing but parsed anyway on the pedagogic concept of limited teaching sets), is not intended to be seniority but instead must be based on the actual acquisition of the requisite skills and knowledge. This is to be determined in real time by the program, the faculty, and the trainees.

Lastly, we fully agree with Luning Prak et al. that evaluation of competency is complex and fits no one format. We did not mean to imply that “hands-on” experiences should be in any way minimized. We state that knowledge and skill set acquisition is the main goal. In the examples provided by Luning Prak et al., we agree that this likely is best attained by hands-on training. Rather, we emphasize in the curriculum that technical performance does not replace, nor does it compensate for, clinical knowledge and competency. Problem solving, including data analysis, is often the best way to learn and to judge the extent of that learning.

In closing, we hope that others engage with us in the dialog to strengthen the CP/LM training experience, as the proposed curriculum is a living document meant for adaptation and developmental growth.

Reference