The In-Training Examination in Internal Medicine: An Analysis of Resident Performance over Time

Richard A. Garibaldi, MD; Raja Subhiyah, PhD; Mary E. Moore, PhD, MD; and Herbert Waxman, MD

Background: **The In-Training Examination in Internal Medicine (IM-ITE) has been offered annually to all trainees in U.S. medical residency programs since 1988. Its purpose is to provide residents and program directors with an objective assessment of each resident's personal performance on a written, multiple-choice examination and the performance of the residency program compared with that of its peers.**

Objective: **To analyze trends in the demographic characteristics and scores of examinees during the first 12 years of administration of this examination.**

Design: **Descriptive analysis over time.**

Setting: **U.S. residency programs in internal medicine, 1988–2000.**

Participants: **Residents at all levels of training in categorical, primary care, and medicine–pediatrics programs in the United States and Canada. The number of examinees increased from 7500 in 1988 to almost 18 000 in 2000.**

Measurements: **After calibration of the scores for each examination, test results were compared and analyzed for selected cohorts of residents over 12 years.**

Results: **More than 80% of residents in medicine training programs participate in the IM-ITE, most on an annual basis throughout their period of training. Test performance improves at a predictable rate with each year of training. Since 1995, international medical school graduates have persistently outperformed graduates of U.S. medical schools. Test results were affected by the timing of the examination, the time that was available to complete the examination, and the actual time that residents spent in internal medicine training before each examination.**

Conclusions: **The IM-ITE scores generally improve with year of training time spent in internal medicine training before the examination and time permitted to complete the examination. These observations provide evidence that the IM-ITE is a valid measure of knowledge acquired during internal medicine training.**

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For author affiliations, see end of text.

The In-Training Examination in Internal Medicine (IM-ITE) was first administered in 1988. It was developed to serve as a self-evaluation instrument for internal medicine housestaff at the midpoint of their residency training. Since its introduction, the IM-ITE has been administered annually to residents on a voluntary basis. Now, more than 395 residency training programs in the United States, 13 programs in Canada, and 9 programs in Puerto Rico participate in the examination. Most residency training programs offer the examination for postgraduate year (PGY) 1 residents and PGY3 residents in addition to PGY2 residents. In the 1999–2000 academic year, almost 18 000 residents took the examination; this included more than 80% of the residents enrolled in internal medicine programs in the United States.

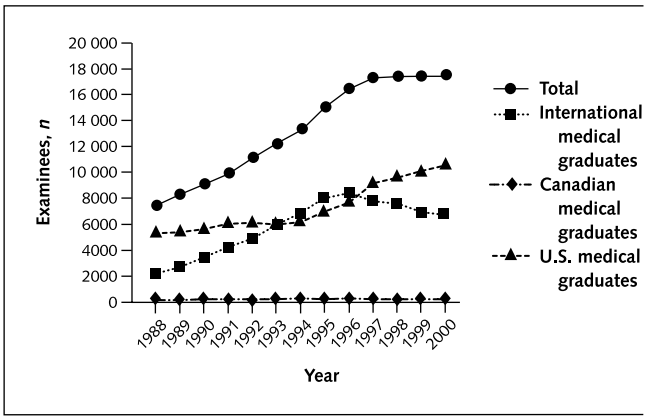
This report reviews the demographic characteristics of the trainees who have participated in the IM-ITE over the past 12 years and analyzes trends in test results. It builds on data first presented in 1994 that reviewed trends during the first 6 years of testing (1), provides insights into the effect of changes in housestaff composition on performances in the examination over time, and analyzes the effect of changes in test administration on examination scores.

BACKGROUND

The IM-ITE was developed in the late 1980s and was first administered in 1988 as a cooperative effort of the American College of Physicians (now the American College of Physicians–American Society of Internal Medicine [ACP–ASIM]), the Association of Program Directors in Internal Medicine (APDIM), and the Association of Professors of Medicine (APM) (1). The examination is intended to be used solely as an educational resource. It provides residents with a measure of their knowledge in general internal medicine and its subspecialties compared with that of their peers nationwide. It also provides program directors with an assessment of their own residents and compares the overall performance of their program by level of training to the performance of a national cohort. Results on the IM-ITE are not meant to be used as criteria for promotion or termination within a residency program or to determine eligibility for participation in the certification examination of the American Board of Internal Medicine. Furthermore, it is specifically stated in each examination booklet that the results of the IM-ITE should not be used by outside regulatory agencies to measure the knowledge of individual residents or the quality of individual training programs (1).

The examination tests the knowledge base of PGY2 residents, although residents at all levels of training now participate in the examination on an annual basis. Each examination is prepared by a committee composed of three representatives from each of the sponsoring societies and a chairperson appointed by the ACP–ASIM. The committee members serve staggered terms of 3 years each to maintain a high level of continuity in the examination from year to year. Committee members have expertise in the fields of general internal medicine and each of the subspecialties of internal medicine.

Figure 1. **Number of examinees by country of medical school training, 1988–2000.**



The total number of persons taking the examination (*circles*) is shown, as well as the number of examinees according to region of medical school training—United States (*triangles*), Canada (*diamonds*), or international (non–U.S. or Canada) (*squares*).

Preparation of questions for the examination begins 1.5 years before the administration date. The content of the examination is driven by a blueprint that allocates approximately 20% of test items to general internal medicine and 7% to 15% to each subspecialty. Questions are designed to test the residents' knowledge of physical examination skills, diagnostic acumen, and appropriate therapy. (For sample questions, see Appendix, available at www.annals.org.) The examination emphasizes items that involve synthesis and judgment rather than simple recall. To increase reliability, 25% to 50% of questions are selected from examinations given 2 or more years previously on the basis of their content and performance characteristics. New questions are written, edited, and reviewed by the examination committee. The examination consists of 350 to 375 test items. Before 1995, the examination was administered in two sessions of 3 hours each; in 1995, the time for each session was increased to 3.5 hours.

Test booklets are prepared by the ACP–ASIM and distributed to the testing site of each participating residency program. Program directors are responsible for administering the test, including proctoring, maintaining security, reporting irregularities, and returning materials to the National Board of Medical Examiners (NBME) for scoring. Before 1999, the examination had been administered in January. However, since the 1999–2000 academic year, the examination is administered in October, 3 months earlier, to obtain results earlier in the year for each cohort of residents and to avoid interference with resident recruitment.

The NBME statistically analyzes the performance characteristics of each question on the IM-ITE. Questions that are answered correctly by fewer than 30% of residents and those that fail to discriminate high-scoring from low-scoring examinees are closely reviewed by the committee chairperson to determine whether results of that item should be included in the overall test score. In addition, each year the performances of the total test and each subspecialty section are analyzed for their quality and internal consistency. The precision of scores for the total examination, as measured by the Kuder–Richardson reliability coefficient (KR_{20}) (2), is consistently at a level similar to that found in national certifying examinations and state licensing tests ($KR_{20} > 90$).

Each resident receives a report that compares his or her overall score with that of a national cohort of peers at the same level of training. Residents also receive scores on each subspecialty section of the examination and a listing of educational objectives for questions answered incorrectly. Program directors receive copies of the individual reports for each of their residents and composite scores of their residents by level of training compared with those of their peers for the total examination and each of its subsections.

METHODS

This report reviews trends in the performance characteristics of annual examinations from 1988 to 2000 (the 1999–2000 academic year). For this study, numeric data, demographic characteristics, and test scores for each annual examination were calculated and analyzed. Results from each examination were calibrated by using the Rasch model (3). The calibration procedure estimates the difficulty of each examination item independently of examinee proficiency. Conversely, examinee proficiencies are estimated independently of item difficulty. The examinees' proficiencies for each year were equated and placed on a common scale. In this study, scores were equated to a baseline benchmark score (±SD) of 500 ± 100 for PGY2 residents who took the 1988 examination. This allowed direct comparison of test difficulty and examinee performance across the 12 years of our analysis.

RESULTS

Program Participation

Country of Medical School Training

The number of residents participating in the IM-ITE increased from 7537 in 1988 to 17 883 in 1999–2000. This number plateaued over the last 4 years of the analysis, reflecting participation by more than 80% of the total residents in internal medicine training programs in the United States (**Figure 1**). Over the 12-year period analyzed, the number of residents who graduated from U.S. medical schools increased steadily. Included in the group of U.S. medical school graduates are residents who graduated from U.S. schools of osteopathic medicine. Their numbers increased from 374 in 1989 to 850 in 1999–2000. Each year, osteopathic medical school graduates have represented 4% to 5% of the examinees. The number of graduates from international programs taking the examination increased rapidly from 1988 to 1996 and tailed off

for the last 4 years of the analysis. From 1994 to 1996, the numbers of international graduates who took the examination exceeded the number of U.S. graduates. In the 1999–2000 examination, approximately 60% of examinees were U.S. medical school graduates and 40% were international medical school graduates. The number of graduates from Canadian medical schools participating in the examination increased slightly from 184 in 1988 to 368 in 1999–2000, peaking at 429 in 1996.

Type of Training Program

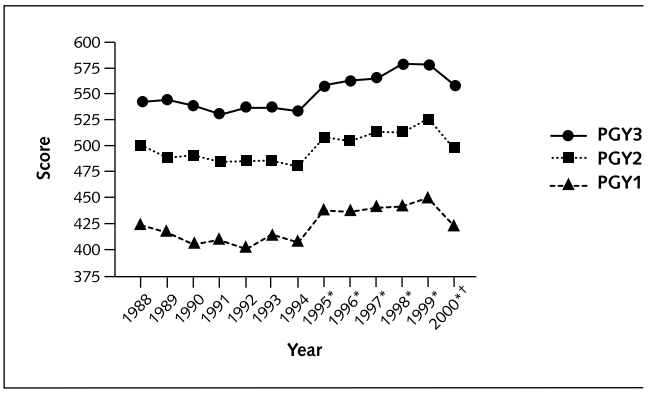
Most housestaff taking the IM-ITE are enrolled in categorical programs. The numbers of residents in categorical programs increased from 4175 in 1988 to 13 642 in 1999–2000, reflecting the increased participation of categorical programs in the examination process in the United States. The number of residents from primary care general internal medicine programs decreased from 1988 to 1994 and recovered in the last four examinations of our analysis; in 1999–2000, 2126 primary care residents took the IM-ITE. The greatest increase in participation over the 12-year period was seen among medicine–pediatrics residents, whose numbers increased fivefold, from 253 in 1988 to 1269 in 1999–2000. Also of note, the number of residents (PGY1) in preliminary medicine programs taking the examination increased over the 12-year period, reflecting the increased participation of PGY1 housestaff overall in the examination; in 1999–2000, 511 interns in preliminary medicine programs took the examination.

Test Results

PGY Levels

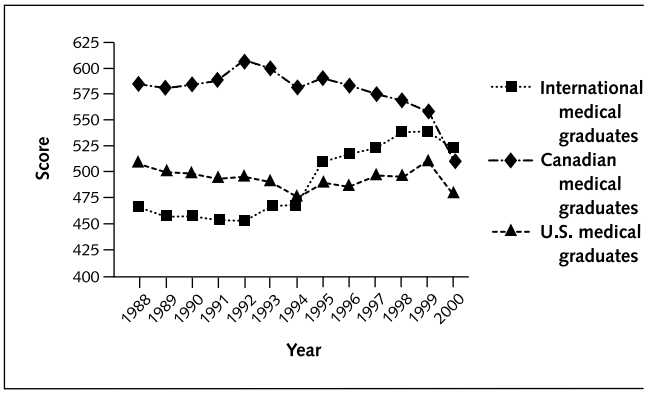
Figure 2 shows annual examination scores from 1988 to 2000 for residents at the PGY1, PGY2, and PGY3 levels. As expected, on every examination, PGY3 residents outperformed PGY2 residents, who outperformed PGY1 residents. The relative difference in scores between PGY3 and PGY2 residents on each examination is between 40 and 60 points (approximately 0.5 SD); the relative difference between PGY2 and PGY1 residents on each examination is between 70 and 80 points (approximately 0.75 SD).

Figure 2. **Mean scores per year, 1988–2000, of examinees by year of postgraduate year of training.**



*Duration of examination increased from 6 to 7 hours. †Examination administered in October instead of January. PGY1 = postgraduate year 1; PGY2 = postgraduate year 2; PGY3 = postgraduate year 3.

Figure 3. **Mean examination scores per year, 1988–2000, according to country of medical school training.**



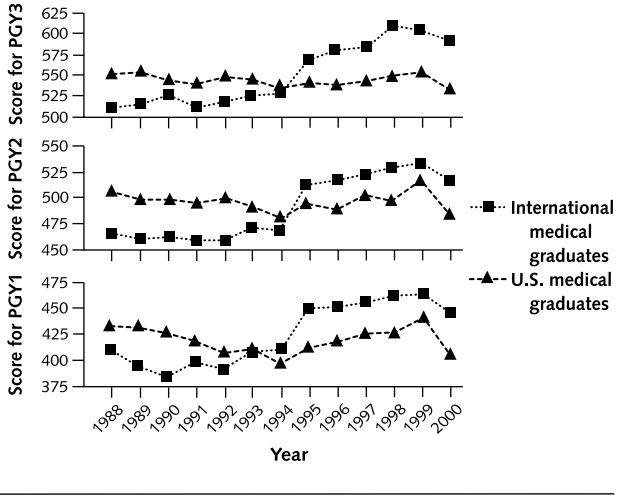
Shown are the scores for graduates of U.S. medical schools (*triangles*), Canadian medical schools (*diamonds*), and international (non–U.S. or Canadian) medical schools (*squares*).

For the first 6 years, the performance of residents at each level of training was consistent, with a slight downward trend. In 1995, however, there was a striking increase in scores in all PGY levels that persisted until 1999–2000. Of note, in 1995 the time allowed to complete the examination was increased from 6 to 7 hours, and this seems to explain the improvement in performance. The decline in performances in the 1999–2000 examination relates to the date of test administration. The 1999–2000 examination was administered in October 1999; this was 3 months earlier in the academic year than all previous examinations, which had been administered in January. The differences in scores for the PGY1 and PGY2 cohorts who took the examination in January 1999 and again 9 months later in October 1999 as PGY2 and PGY3 residents were three quarters of that which might have been anticipated on the basis of performances by residents at these levels of training on previous examinations.

Country of Medical School Training

For the first 7 years that the examination was administered, graduates of U.S. medical schools consistently scored higher than graduates of international medical schools (**Figure 3**). Since 1995, international graduates consistently outperformed U.S. graduates on each examination and scored highest of all cohorts on the most recent examination. We observed the most dramatic increase in scores among international graduates in 1995, when their average total score rose by almost 50 points (0.5 SD), probably because of the extra time allotted for completion of the examination. Graduates of Canadian medical schools have scored strikingly higher than either group on all examinations except in the 1999–2000 academic year.

Figure 4. **Mean examination scores, 1988–2000, for graduates of U.S. medical schools (*circles*) and for graduates of international (non–U.S.) medical schools (*squares*).**



Top. Examinees in postgraduate year 3 (*PGY3*) of U.S. residency training. **Middle.** Examinees in postgraduate year 2 (*PGY2*) of U.S. residency training. **Bottom.** Examinees in postgraduate year 1 (*PGY1*) of U.S. residency training.

The likelihood that the improved performance by international graduates on the 1995 examination and on subsequent examinations was related to the increased time for completion of the examination is substantiated by the observation that marked increases in scores for international graduates were noted for all three PGY levels in the same year (**Figure 4**). Because this occurred in a single year (rather than sequentially over 3 years), the improvement is probably explained by an external factor, such as the time allotted for completion of the examination, rather than a greater proficiency among the international medical school graduates (which would have been reflected in a 3-year trend, as the cohort progressed from PGY1 to PGY3). This interpretation is further verified by an observed 44-point increase from the 1994 to 1995 examination scores among residents who reported that English was not their native language, compared with a 13-point increase in the scores of native English speakers (data not shown). On all examinations before 1995, native English speakers outscored non–native English speakers; on all subsequent examinations, residents for whom English was not their primary language outscored their English-speaking counterparts.

Since 1995, graduates from international medical schools have scored higher than graduates from U.S. medical schools on every examination at every PGY level. For the cohorts of interns who began their training in 1996, 1997, or 1998, PGY1 graduates of international medical schools consistently scored higher than their U.S.-trained counterparts. Between PGY1 and PGY2, cohorts of international medical school graduates and U.S. medical school graduates improved their performance by approximately 75 points on subsequent examinations. Between PGY2 and PGY3, the magnitude of improvement for international graduates continued at the same pace; however, the increased score of U.S. graduates amounted to only two thirds of the anticipated score (**Figure 5**).

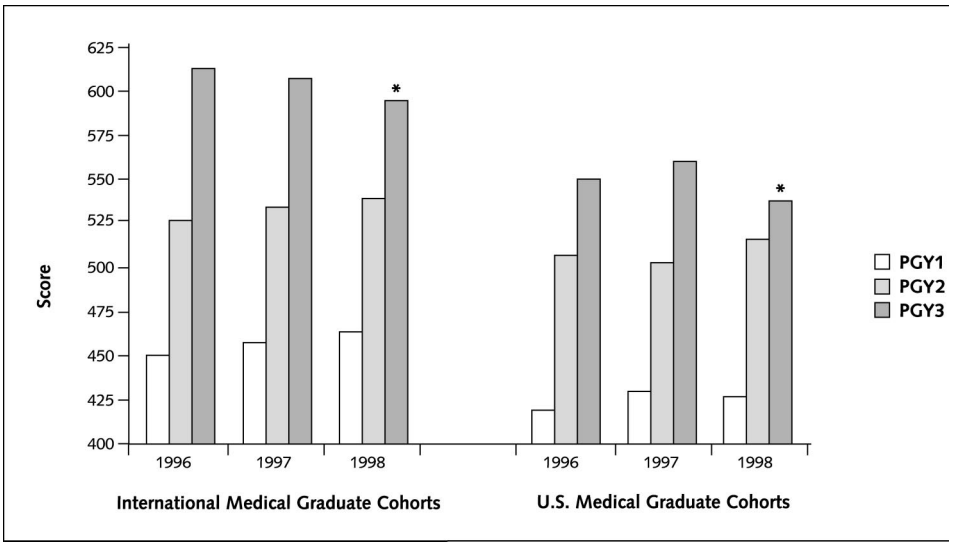
Type of Training Program

The average scores of residents who were enrolled in residency programs for primary care internal medicine were similar to those of residents enrolled in categorical programs. This observation held true for interns in their first year of testing and for residents in their PGY2 and PGY3 years for all examinations. However, the average scores of residents enrolled in medicine–pediatrics programs or preliminary medicine (internship) programs were significantly lower than those of residents enrolled in categorical or primary care programs. It should be noted that training in medicine–pediatrics is 4 years, with 2 years in medicine and 2 years in pediatrics; thus, during each year of training, medicine–pediatrics residents spend approximately half of their time, on average, on medicine rotations. When examined 6 months into their internship, the average scores of medicine–pediatrics PGY1s were 20 to 25 points lower than those of interns who graduated from U.S. medical schools and were enrolled in categorical or primary care programs. For a given cohort of medicine–pediatrics residents, the average increase of scores from PGY1 to PGY2, from PGY2 to PGY3, and from PGY3 to PGY4 was 50 points annually compared with an average annual increase of 75 points in the scores of U.S. and international medical school graduates in internal medicine and primary care programs between PGY1 and PGY2 and for international graduates between PGY2 and PGY3. Thus, the increases in total score between PGY1 and graduation were between 130 and 150 points for all groups (data not shown). After 4 years of training, the residents in medicine–pediatrics programs scored only slightly below the levels of U.S. medical school graduates completing categorical or primary care programs.

DISCUSSION

The IM-ITE is a resource for residents to compare their knowledge with that of their peers. The scores of residents on the IM-ITE have been shown by others to correlate closely with the pass–fail results on the certifying examination of the American Board of Internal Medicine (4–7). Indeed, the IM-ITE is a useful tool for gauging the readiness of a resident to perform well on that examination. The IM-ITE is also a useful measure for annually assessing the rate of improvement of a resident's knowledge during his or her housestaff training. It is a method to evaluate "work in progress." However, absolute scores on the examination are affected by nuances in the test administration. Results are affected by the timing of the examination and the time available to complete the exam, as well

Figure 5. **Comparison of scores on consecutive annual examinations between international medical graduates and U.S. medical school graduates who began their training in 1996, 1997, or 1998.**



In each cohort (based on year in which training began—1996, 1997, or 1998), resident performance on the examination is shown by training year (postgraduate year 1, 2, or 3 [*PGY1*, *PGY2*, *PGY3*]). *Examination was administered in October instead of January.

as the actual time that residents spend in internal medicine training experiences before taking the examination.

The IM-ITE provides residents and program directors with a snapshot of a resident's knowledge as assessed by a written examination at specific points of time during residency training. The examination is reliable, accurate, and internally consistent ($KR_{20} = 0.94$). Now that it has been equated to a target reference point, annual examinations may be compared and analyzed to determine trends over time and to assess improvements in the performances of specific cohorts of residents. For instance, the average score on the examination for a given cohort of residents increases by 75 points between years of training. Increases in scores in this range were noted for almost all cohorts of U.S. and international medical school graduates from categorical and primary care programs between PGY1 and PGY2 and for international medical school graduates between PGY2 and PGY3. The relative decline in performance improvement for U.S. graduates between PGY2 and PGY3 is not easy to explain; possible explanations include complacency or lack of effort by PGY3 graduates of U.S. medical schools; excessive time moonlighting (8); better preparation by international graduates; or some other, as-yet unknown reason.

The striking increase in scores on the examination for residents at all levels of training in 1995 is probably related to the increased time allotted for completion of the examination. This improvement in performance occurred almost exclusively in international graduates; in particular, it occurred in residents for whom English was not their native language. The IM-ITE was never intended to be a "speed" examination—that is, an examination in which residents are tested not only for their knowledge but also for their ability to complete the test in a prescribed time. However, previous analysis has shown that performance on items that appeared toward the end of the test booklet for each section failed to discriminate persons with high scores from those with low scores. By increasing the time for completion of the test, this problem was solved, and the examination performance improved accordingly for non-native English-speaking international graduates.

The across-the-board decreases in scores in the 1999–2000 examination for all PGY levels are probably related to the timing of this examination. All previous examinations had been administered in January, giving a consistent 12-month period between examinations. The 1999–2000 examination was administered 3 months earlier, in October. As a result, the interexamination in-training time for PGY2 and PGY3 residents was reduced from 12 to 9 months after their previous examination, and PGY1 housestaff were tested 3 months, rather than 6 months, into their internship. On this examination, there was a decrease between the observed and expected scores of approximately 25% at all levels of training. Upper-level medicine–pediatrics residents were affected most by the change in the timing of the examination because their in-training time in internal medicine rotations was on average only 4.5 months between the 1999 examination and the 1999–2000 examination.

For all examinations, the magnitude of improvement between examinations was less for medicine–pediatrics residents than for residents in categorical or primary care programs. This is probably related to the fact that medicine–pediatrics residents devote, on average, only half of their time each year to training in internal medicine. The scores for medicine–pediatrics residents increased an average of

50 points per year, compared with an average of 75 points per year seen in cohorts of residents in other programs. The improvement in test scores over the 4 years of training by medicine–pediatrics residents is only slightly below that observed for cohorts of U.S. graduates in categorical or primary care programs over their 3 years of training.

Residents and program directors find the IM-ITE extremely valuable (1). Residents use their results to identify their areas of relative proficiency and deficiency as they prepare for the certifying examination of the American Board of Internal Medicine. Program directors use the results of the examination to counsel low-scoring residents and to rearrange rotations or set up self-study programs to meet the unique needs of individual residents. However, the IM-ITE does not discriminate "good" residents from "bad" residents or "good" physicians from "bad" physicians. In fact, program directors, supervising residents, and the individual residents have difficulty correlating the scores on the IM-ITE or other in-training examinations with ward or clinic performances (9–11). The IM-ITE is not a substitute for evaluating skills that can be assessed only by direct observation. It is only one measure, albeit a very useful measure, for evaluating the improvement in a resident's base of knowledge over time (12).

From the University of Connecticut School of Medicine, Farmington, Connecticut; the National Board of Medical Examiners, Philadelphia, Pennsylvania; and the American College of Physicians–American Society of Internal Medicine, Philadelphia, Pennsylvania.

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Requests for Single Reprints: Richard A. Garibaldi, MD, Department of Medicine, University of Connecticut Health Center, 263 Farmington Avenue, Farmington, CT 06030.

The Appendix and current author addresses are available at www.annals.org.

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Current Author Addresses: Dr. Garibaldi: Department of Medicine, University of Connecticut Health Center, 263 Farmington Avenue, Farmington, CT 06030.
Dr. Subhiyah: National Board of Medical Examiners, 3750 Market Street, Philadelphia, PA 19104.
Dr. Moore: 364 Youngsford Place, Gladwyne, PA 19035.
Dr. Waxman: American College of Physicians–American Society of Internal Medicine, 190 N. Independence Mall West, Philadelphia, PA 19106-1572.

Appendix: Four Typical Test Questions on the In-Training Examination in Internal Medicine

Item 1

You are asked to evaluate an 82-year-old diabetic man for elective inguinal hernia repair to be done under general anesthesia.

Which of the following findings is the best marker for increased perioperative cardiovascular risk?

a) Stable angina pectoris requiring antianginal medications

b) Myocardial infarction 2 years previously

c) Left ventricular ejection fraction of 40%

d) A systolic murmur consistent with aortic stenosis and an aortic valve area estimated by Doppler echocardiography to be 2 cm^2

e) An S_3 gallop

Item 2

A 67-year-old woman presents to the emergency department following one week of palpitations and increasing dyspnea. She has a history of chronic mitral insufficiency. Her only medication is oral enalapril for hypertension. Her electrocardiogram shows atrial fibrillation. Two weeks ago, her electrocardiogram showed normal sinus rhythm. Following treatment with digoxin and diuretics, her dyspnea resolves. On physical examination, her pulse rate is 76/min and irregular, and blood pressure is 130/72 mm Hg. Neck veins reveal a normal jugular venous pressure; the lungs are clear. On auscultation the heart has a grade 3/6 holosystolic murmur at the apex and an S_3.

The most appropriate method for cardioversion would be:

a) Intravenous procainamide

b) Oral warfarin for 3 weeks followed by electrical cardioversion

c) Intravenous heparin for 24 hours followed by electrical cardioversion

d) Oral aspirin for 3 weeks followed by electrical cardioversion

e) Oral amiodarone

Item 3

A dentist calls you for advice about a 16-year-old boy who has mitral regurgitation and now needs his teeth cleaned. He has been receiving benzathine penicillin, 1.2 million units intramuscularly every 4 weeks, since he had acute rheumatic fever 3 years ago.

Which of the following should you tell the patient's dentist?

a) Additional prophylaxis for endocarditis with ciprofloxacin, 500 mg orally, 1 hour before the procedure and a second dose 6 hours later

b) Additional prophylaxis for endocarditis is not needed because the patient is already taking penicillin.

c) Additional prophylaxis for endocarditis is not needed because the patient is not having a tooth extracted.

d) Because this patient has an exceptionally high risk for endocarditis, he should receive prophylaxis with intravenous vancomycin, 1.0 g, and intravenous gentamicin, 1.5 mg/kg.

e) Monthly benzathine penicillin is not optimal prophylaxis, and the patient should receive oral clindamycin, 600 mg, 1 hour before the procedure and no additional therapy following the procedure.

Item 4

A 43-year-old man with a history of illicit substance use presents because he has difficulty moving his right hand. On examination, he has a heart murmur, his grip strength is normal, the abductors and adductors of the fingers are normal, and the extensors of the right wrist and digits are profoundly weak.

The most likely diagnosis is:

a) Brain abscess in the left frontal lobe

b) Brain stem infarct in the right pons

c) Lesion of the right lower brachial plexus (thoracic outlet)

d) Lesion of the median nerve at the right elbow

e) Lesion of the radial nerve in the right arm