

Guidelines for Fellowship Training in Regional Anesthesiology and Acute Pain Medicine

Second Edition, 2010

The Regional Anesthesiology and Acute Pain Medicine Fellowship Directors Group

Abstract: The Regional Anesthesiology and Acute Pain Medicine Fellowship Directors Group develops and maintains guidelines for fellowship training in the subspecialty. These guidelines update the original guidelines that were published in 2005. The guidelines address 3 major topic areas: organization and resources, the educational program, and the evaluation process.

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PREAMBLE

This is a consensus document developed and maintained by Regional Anesthesiology and Acute Pain Medicine fellowship directors and their colleagues (The Group). The Group was formed in 2002 as an international collaboration of fellowship directors and associate directors (Appendix 1) and others (Appendix 2) interested in advanced regional anesthesiology and acute pain medicine training. The Group provides a forum for discussion of issues related to fellowship design, administration, and common concerns. Membership is open to all interested individuals, with each institution granted 1 vote. The Group typically meets twice a year (during the American Society of Regional Anesthesia and Pain Medicine spring meeting and during the fall American Society of Anesthesiologists annual meeting). Members of this group work collaboratively on initiatives to continually improve the fellowship experience.

This document was initially created in 2002, approved by The Group in 2003, and published in *Regional Anesthesia and Pain Medicine* in 2005.¹ The Group agreed that this document would be reviewed every 3 years, being mindful of developments in the practice of regional anesthesiology and acute pain medicine. This document was reviewed without change in 2006. In 2009, several changes were approved, including reorganization of the document. The most important changes reflect the progression of ultrasound-guided regional anesthesia as a tool for nerve localization, increase the emphasis on knowledge related to complications specific to the subspecialty, and stress the progressive intertwinement of acute pain medicine with peri-

operative anesthetic procedures. Final approval of this document occurred at The Group's October 2010 meeting.

Regional Anesthesiology and Acute Pain Medicine is not a subspecialty accredited by the Accreditation Council for Graduate Medical Education (ACGME). As such, these guidelines for Fellowship Training in Regional Anesthesiology and Acute Pain Medicine represent the consensus of peers. The guidelines are not intended as absolute programmatic requirements, nor should they be construed to define standard of care. As detailed in its mission statement, The Group acknowledges that individual fellowship programs can vary from these guidelines and yet maintain a high level of proficiency and integrity.

MISSION STATEMENT

The purpose of this endeavor is to recommend the necessary components of subspecialty fellowship training in Regional Anesthesiology and Acute Pain Medicine. Although an effort has been made to create a comprehensive set of goals and competency-based objectives, these recommendations may not apply to all programs, nor will they be used for any form of accreditation of fellowship programs. Participating fellowship program directors will ensure the ongoing development of regional anesthesiology and acute pain medicine as a defined subspecialty. Educational curricula, clinical care, and research activities are emphasized.

PROGRAMMATIC GOALS FOR FELLOWSHIP TRAINING IN REGIONAL ANESTHESIOLOGY AND ACUTE PAIN MEDICINE

- I. Organization and resources
 - a. Scope and duration of training
 - b. Institutional organization
 - c. Program director and faculty
 - d. Facilities and resources
- II. The education program
 - a. Program goals
 - b. Medical knowledge
 - c. Patient care
 - d. Scholarly activities/practice-based learning
 - e. Interpersonal and communication skills
 - f. Professionalism
 - g. Systems-based practice
- III. The evaluation process

I. Organization and Resources

a. Scope and Duration of Training

1. *Scope of Training.* Regional anesthesiology and acute pain medicine is a subspecialty focused on the perioperative management of patients receiving neuraxial or peripheral neural blockade for anesthesia and/or acute analgesia.

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James P. Rathmell, MD, served as acting editor-in-chief for this article. The Regional Anesthesiology and Acute Pain Medicine Fellowship Directors Group collaboratively developed and approved the content of these guidelines.

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Specifically, the setting of this training might include (a) intraoperative application (with or without general anesthesia), (b) postoperative application in inpatients and outpatients, and/or (c) acute pain management of nonsurgical patients. Fellowship training should be concerned with the development of expertise in the practice and theory of regional anesthesiology and acute pain medicine.

2. *Duration of Training.* The time required for subspecialty training in regional anesthesiology and acute pain medicine shall be 12 months. Program directors are granted flexibility to tailor the program to meet the individual needs of fellows. Specialized clinical rotations of less than 12 months may be made available to interested clinicians, but the minimum amount of training necessary to use “fellowship” in the diploma language shall be 1 year.

b. Institutional Organization

1. *Relationship to a Core Program.* Institutions with subspecialty training in regional anesthesiology and acute pain medicine must have a direct affiliation with an ACGME-accredited residency in anesthesiology (or similar, e.g., Royal College of Physicians and Surgeons of Canada or Royal College of Anaesthetists). If the institution at which the fellowship is based is other than the primary institution of an accredited residency, a written agreement linking the two is required. An evaluation protocol consistent with ACGME (or equivalent)-approved standards for residency programs is also a prerequisite.
2. *Institutional Policy and Resources.* The fellowship should be recognized and approved by the core Department of Anesthesiology and the institution’s Department/Division of Medical Education.
3. *Institutional Oversight.* The core program is encouraged to internally review the fellowship program at least every 5 years to ensure general compliance with these guidelines.

c. Program Director and Faculty

1. *Program Director.* The director of the fellowship training program must be an American Board of Anesthesiology-certified anesthesiologist (or equivalent) who has completed 1 year of fellowship training in regional anesthesiology and/or acute pain medicine, or is a dedicated and skilled practitioner of these disciplines. The program director must also have an academic and/or clinical affiliation with an ACGME (or equivalent)-accredited institution.
2. *Faculty.* The majority of the faculty in the training program must be board certified (or equivalent) in anesthesiology. A division of the faculty in the training program must also demonstrate an expertise in regional anesthesiology and/or acute pain medicine. The number of faculty in a program may vary based on the number of fellows in training; however, the program must have a minimum of 2 regional anesthesiology and/or acute pain medicine faculty.

d. Facilities and Resources

1. *Equipment.* Suitable equipment for the performance of a wide variety of regional anesthesia/analgesia techniques must be available. Such equipment must include nerve simulators, neuraxial and peripheral block supplies, catheter systems, ultrasound systems, and the basic requirements for conducting general anesthesia according to American Society of Anesthesiologists standards. Dedicated and acceptable on-call facilities must also be maintained if applicable.

2. *Support Services.* Appropriate support services may include, but are not limited to, anesthesia technical support and pharmacy support systems.
3. *Library.* A departmental library, or a portion of the institutional library dedicated to anesthesiology, must be maintained with literature specific to the practice of regional anesthesiology and acute pain medicine.

II. The Educational Program

a. Program Goals

Over the course of the 12-month fellowship, the fellow will enhance his/her cognitive, psychomotor, and affective skills to safely and effectively administer and teach regional anesthesiology and acute pain medicine as a consultant in anesthesiology. The fellow is responsible for decisions related to case and block selection to facilitate the smooth flow of the operating room (OR) cases and to enhance patient recovery. The fellow will be expected to develop and demonstrate the skills needed to establish regional anesthesiology and acute pain medicine as a primary component of his/her future practice.

b. Medical Knowledge

Upon completion of the program, the fellow should demonstrate knowledge in the following areas sufficient to

1. Local anesthetics

- a) Describe the pharmacology of local anesthetics with respect to mechanism of action, physicochemical properties, comparative attributes, and appropriate dosing for site of single injection or continuous infusion.
- b) Determine the selection and dose of local anesthetics as indicated for specific medical conditions.
- c) Compare the dosing, advantages, and disadvantages of local anesthetic adjuncts.
- d) Compare toxic risk of local anesthetics and signs, symptoms, and treatment of local anesthetic systemic toxicity² or neurotoxicity.

2. Neuraxial and systemic opioids, nonsteroidal anti-inflammatory drugs, and nonopioid adjuncts for analgesia

- a) Neuraxial opioids
 - (1) Describe indications/contraindications, mechanism of action, physicochemical properties, effective dosing, and duration of action of neuraxial opioids.
 - (2) Compare extended release epidural morphine with standard preservative-free opioids.
 - (3) Recognize complications and adverse effects, including related monitoring, prevention, and therapy.³
 - (4) Differentiate intrathecal versus epidural administration relative to dose, effect, and adverse effects.
- b) Systemic Opioids
 - (1) Discuss the pharmacokinetics of opioid analgesics: bioavailability, absorption, distribution, metabolism, and excretion.
 - (2) Discuss the site and mechanism of action of opioids.
 - (3) Discuss the differences of chemical structure of the various opioids.
 - (4) Describe challenges of postprocedure analgesic management in the patient with chronic pain and/or opioid-induced hyperalgesia.
- c) Nonopioid Analgesics
 - (1) Describe the concept of multimodal analgesia and its impact on functional restoration after surgery.
 - (2) Differentiate the pharmacology of NSAIDs, COX-2 inhibitors, *N*-methyl-D-aspartic acid antagonists, α -2

agonists, and γ -aminobutyric acid–pentanoid agents with respect to optimizing postoperative analgesia.

3. Nerve Localization Techniques

- Explain principles, operation, advantages, and limitations of the peripheral nerve stimulator to localize and anesthetize peripheral nerves.
- Explain principles, technique, and advantages and disadvantages of paresthesia-seeking, perivascular or transvascular approaches to nerve localization.
- Explain principles, operation, advantages, and limitations of ultrasound to localize and anesthetize peripheral nerves.⁴⁻⁶

4. Spinal Anesthesia

- Describe the indications, contraindications, adverse effects, complications, and management of spinal anesthesia.
- Recognize the cardiovascular and pulmonary physiological effects of spinal anesthesia.
- Compare local anesthetics for intrathecal use: agents, dosage, surgical and total duration of action, and adjuvants.
- Explain the relative importance of factors affecting intensity, extent, and duration of block such as patient position, dose, volume, and baricity of injectate.
- Define postdural puncture headache, and describe symptoms, etiology, risk factors, and treatment.
- Differentiate advantages and disadvantages of continuous spinal anesthesia.

5. Epidural Anesthesia (Lumbar, Thoracic, Caudal)

- Describe the indications, contraindications, adverse effects, complications, and management of epidural anesthesia.
- Compare the local anesthetics available for epidural use: agents, dosage, adjuncts, and duration of action.
- Differentiate between spinal and epidural anesthesia with regard to reliability, latency, duration, and segmental limitations.
- Explain the value and techniques of test dosing to minimize certain complications of epidural anesthesia.
- Interpret the volume-segment relationship and the effect of patient age, pregnancy, position, and site of injection on resultant block.
- Differentiate combined spinal-epidural anesthesia from lumbar epidural anesthesia, including advantages/disadvantages, dose requirements, complications, indications, and contraindications.
- Categorize outcome benefits of thoracic epidural analgesia for thoracic and abdominal surgery and thoracic trauma.
- Differentiate caudal epidural and thoracic epidural anesthesia from lumbar epidural anesthesia, including advantages/disadvantages, dose requirements, complications, indications, and contraindications.
- Explain the impact of antithrombotic and thrombolytic medications on neuraxial and peripheral anesthesia/analgesia with specific reference to the American Society of Regional Anesthesia and Pain Medicine guidelines: “Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy.”⁷

6. Upper-Extremity Nerve Block⁸

- Describe the anatomy and sonoanatomy of the brachial plexus in relation to sensory and motor innervation.
- Compare local anesthetics for brachial plexus block: agents, dose, duration of action, and adjuvants.
- Explain the value and techniques of intravascular test dosing to minimize local anesthetic systemic toxicity associated with peripheral nerve block.
- Differentiate the various brachial plexus (or terminal nerve) block sites including indications/contraindications,

advantages/disadvantages, complications, and management specific to each.

- Contrast the indications and technique for cervical plexus, suprascapular, or intercostobrachial block as unique blocks, or supplements to brachial plexus block.
- Summarize the use and advantages/disadvantages specific to continuous brachial plexus anesthesia.

7. Lower-Extremity Nerve Block⁹

- Describe anatomy and sonoanatomy of the lower extremity: sciatic, femoral, lateral femoral cutaneous, and obturator nerves (and their clinically important branches) in relation to sensory and motor innervation.
- Compare local anesthetics for lower-extremity block: agents, dose, duration of action, and adjuvants.
- Explain the value and techniques of intravascular test dosing to minimize local anesthetic systemic toxicity associated with peripheral nerve block.
- Differentiate the various approaches to lower-extremity blockade, including indications/contraindications, adverse effects, complications, and management specific to each.
- Summarize the advantages/disadvantages and indications for continuous lower-extremity neural blockade.

8. Truncal Blockade

- Describe the relevant anatomy for intercostal, paravertebral, ilioinguinal-hypogastric, rectus sheath, and transversus abdominus plane blocks.
- Compare local anesthetics for truncal blockade: agents, dose, and duration of action.
- Summarize the indications, contraindications, adverse effects, complications, and management of truncal blockade.

9. Intravenous Regional Anesthesia

- Review the mechanism of action, indications, contraindications, advantages and disadvantages, adverse effects, complications and management of intravenous regional anesthesia (IVRA).
- Compare agents for IVRA: local anesthetic choice, dosage, and use of adjuvants.

10. Complications of Regional Anesthesia and Acute Pain Medicine

Discuss those complications specific to regional anesthesia and acute pain medicine practice. A partial list of these complications includes

- hemorrhagic complications in the patient receiving anti-thrombotic or thrombolytic agents,¹⁰
- infectious complications of neuraxial and peripheral blockade,^{3,11}
- neurological complications of regional anesthesia and acute pain medicine,¹²
- local anesthetic systemic toxicity,² and
- opioid-induced respiratory depression.³

c. Patient Care

Upon completion of the program, the fellow should be able to

- describe rational selection of regional anesthesia and/or postoperative analgesic techniques for specific clinical situations. Such techniques may involve nontechnical options, such as multimodal analgesia, opioid and nonopioid pharmacological management, and so on;
- debate the advantages/disadvantages of regional versus general anesthesia for various procedures and patients in regard to patient recovery, patient outcome, OR efficiency, and cost of care;
- recognize and intervene to manage inadequate operative regional anesthetic and postoperative analgesic techniques

with supplemental blockade, alternative approaches, and/or pharmacological intervention;

4. demonstrate the knowledge and skills necessary to perform and to effectively teach a wide range of advanced practice block techniques, achieving a high success and low complication rate. Examples of blocks in this category, modified from Hadzic et al,¹³ include
 - (1) deep cervical plexus block,
 - (2) suprascapular nerve block,
 - (3) interscalene block,
 - (4) supraclavicular block,
 - (5) infraclavicular block,
 - (6) continuous interscalene block,
 - (7) continuous infraclavicular block,
 - (8) continuous axillary block,
 - (9) intercostal nerve block,
 - (10) thoracolumbar paravertebral block: single or continuous,
 - (11) rectus sheath block,
 - (12) transversus abdominis plane block,
 - (13) ilioinguinal-iliohypogastric block,
 - (14) sciatic nerve block: posterior approaches,
 - (15) sciatic nerve block: anterior approach,
 - (16) sciatic popliteal block,
 - (17) lumbar plexus block,
 - (18) femoral nerve block,
 - (19) lateral femoral cutaneous block,
 - (20) obturator nerve block,
 - (21) saphenous nerve block,
 - (22) continuous femoral nerve block,
 - (23) continuous sciatic nerve block, and
 - (24) continuous popliteal sciatic block;
5. demonstrate an understanding of how the acute pain medicine service addresses (a) surgical regional anesthetic techniques (as placed by the OR anesthesiologist), (b) the perioperative use of analgesic techniques by the acute pain medicine service, (c) the perioperative management of acute pain medicine interventions, (d) the provision of acute pain medicine services directed toward the chronic pain patient who is now experiencing acute pain, and (e) the provision of acute pain management to select nonsurgical patients, such as those with sickle cell anemia.
6. demonstrate the ability to direct the acute pain medicine service with attending supervision. Patient management will include multimodal analgesic techniques such as neuraxial and peripheral nerve catheters, local anesthetic and narcotic infusions, and nonnarcotic analgesic adjuvants.

d. Scholarly Activities/Practice-Based Learning

1. Academic Activities

- a) Fellows are encouraged to participate in research as a major activity of the yearlong fellowship. To accomplish these objectives, the regional anesthesiology and acute pain medicine faculty will mentor the fellow in the production of research, coauthorship of papers as appropriate, and preparation of clinical research proposals with institutional review board approval prior to the start of the fellowship year.

2. Teaching Activities

- a) Create and present a lecture during departmental or divisional grand rounds, or a local/regional/national meeting covering a topic or case relevant to regional anesthesia or acute pain medicine.
- b) Prepare resident education lectures and journal reviews for regional anesthesiology and/or acute pain medicine subspecialty conference.

- c) Participate and direct portions of cadaver anatomy laboratories if available.
- d) Develop teaching techniques by instructing residents and/or medical students at the bedside under the supervision of faculty.
- e) Review and enhance Web-based teaching resources such as resident teaching materials, curriculum documents, and self-study and testing materials.

3. Practice-Based Learning

- a) Evaluate and apply evidence from scientific studies, expert guidelines, and practice pathways to their patients' medical conditions.
- b) Apply information technology to obtain and record patient information, access institutional and national policies and guidelines, and participate in self-education.
- c) Analyze their own practice with respect to patient outcomes (especially success and complications from regional blockade) and compare with available literature.

e. Interpersonal and Communication Skills

Upon completion of the program, the fellow should be able to

1. summarize information to the patient and family with respect to the options, alternatives, risks and benefits of regional anesthesia, and/or acute analgesic techniques in a manner that is clear, understandable, ethical, and appropriate;
2. develop effective listening skills and answer questions appropriately in the process of obtaining informed consent; and
3. operate effectively in a team environment and communicating and cooperating with surgeons, residents, nurses, pharmacists, physical therapists, and other members of the perioperative team. This requires the fellow to
 - a) recognize the roles of other members of the team,
 - b) communicate clearly in a collegial manner that facilitates the achievement of care goals,
 - c) help other members of the team to enhance the sharing of important information, and
 - d) formulate care plans that utilize the multidisciplinary team skills, such as a plan for facilitated recovery.

f. Professionalism

Upon completion of the program, the fellow should be able to

1. continuously conduct the practice of medicine with integrity, honesty, and accountability;
2. demonstrate a commitment to lifelong learning and excellence in practice;
3. practice consistent subjugation of self-interest to the good of the patient and the health care needs of society; and
4. demonstrate a commitment to ethical principles in providing care, obtaining informed consent, and maintaining patient confidentiality.

g. Systems-Based Practice

Upon completion of the program, the fellow should be able to

1. effectively balance the need for OR efficiency with high-quality patient care. The fellow will effectively choose surgeons, patients, techniques, and approaches to achieve the best balance possible to use regional anesthesia and/or analgesia to improve patient outcomes;
2. understand the interaction of the acute pain medicine service with other elements of the health care system including primary surgical and medical teams and other consultant, nursing, pharmacy, and physical therapy services;

3. demonstrate awareness of health care costs and resource allocation, and the impact of their choices on those costs and resources; and
4. advocate for the patient and their family within the health care system and assist them in understanding and negotiating complexities in that system.

III. The Evaluation Process

- A. Consistent with ACGME Residency Guidelines,¹⁴ the attending faculty will be evaluated by the fellows at least annually.
- B. Written evaluations of fellows by all faculty with whom they have worked shall occur at least every 6 months. The results of these evaluations shall be recorded and reviewed with the fellows by the program director or faculty advisor no less often than every 6 months.
- C. A review will be conducted at least twice annually to assess professional development.
- D. A 360-degree assessment process will occur at least annually.

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APPENDIX 1. Regional Anesthesiology and Acute Pain Medicine Fellowship Directors and Associate Directors, 2010

| Director/Associate Director | Institution |
|--|---|
| Matthew Abrahams, MD | Oregon Health Sciences University, Portland, Ore |
| Juan-Francisco Asenjo, MD | McGill University, Montreal, Quebec, Canada |
| Jonathan C. Beathe, MD | Hospital for Special Surgery, New York, NY |
| Andre P. Boezaart, MD, PhD | University of Florida, Gainesville, Fla |
| A. Robin Brown, MB, ChB, FFA (SA) | New York Presbyterian/Columbia University, New York, NY |
| Richard T. Brull, MD, FRCPC | University of Toronto, Toronto, Ontario, Canada |
| Chester C. Buckenmeier III, MD | Walter Reed National Military Medical Center, Washington, DC |
| David Burns, MD | Penn State Health Sciences, Hershey, Pa |
| Jacques Chelly, MD | University of Pittsburgh, Pittsburgh, Pa |
| Peter Foldes, MD | University of Iowa, Iowa City, Iowa |
| Michael Ford, MD | University of Wisconsin, Madison, Wis |
| Jeff Gadsen, MD | St Luke's-Roosevelt Medical Center, New York, NY |
| Ralf Gebbard, MD | University of Miami, Miami, Fla |
| Roy A. Greengrass, MD | Mayo Clinic College of Medicine, Jacksonville, Fla |
| Thomas Halszynki, MD | Yale University, New Haven, Conn |
| Gregory Hickman, MD | Andrews-Paulos Research and Education Institute, Gulf Breeze, Fla |
| Brian Ilfeld, MD, MS | University of California, San Diego, San Diego, Calif |
| Raymond S. Joseph, MD | Virginia Mason Medical Center, Seattle, Wash |
| Stephen M. Klein, MD | Duke University, Durham, NC |
| Sandra L. Kopp, MD | Mayo Clinic College of Medicine, Rochester, Minn |
| Kanupriya Kumar, MD | Johns Hopkins University, Baltimore, Md |
| Linda Le-Wendling, MD | University of Florida, Gainesville, Fla |
| Danielle B. Ludwin, MD | New York Presbyterian/Columbia University, New York, NY |
| Randall Malchow, MD | Vanderbilt University, Nashville, Tenn |
| Edward Mariano, MD | Stanford University, Palo Alto, Calif |
| Colin J. L. McCartney, MB, ChB, FFARCSI, FRCA | University of Toronto, Toronto, ON |
| Paul McHardy, MD | The Hospital for Sick Children, Toronto, Ontario, Canada |
| Andres Missair, MD | University of Miami, Miami, Fla |
| Karen C. Nielsen, MD | Duke University, Durham, NC |
| Desiree Persaud, MD | University of Ottawa, Ottawa, Ontario, Canada |
| Brian Pollard, MD, Med, FRCPC | St Michael's Hospital Toronto, Ontario, Canada |
| Meg A. Rosenblatt, MD | Mount Sinai Medical Center, New York, NY |
| Richard Rosenquist, MD | University of Iowa, Iowa City, Iowa |
| Alireza Sadoughi, MD | University of California, Los Angeles, Los Angeles, Md |
| Didier Sciard, MD | University of Texas Medical Branch, Galveston, Tex |
| Brian D. Sites, MD | Dartmouth University, Lebanon, NH |
| Steven Suydam, MD | University of California, Irvine, Orange, Calif |
| Ban Tsui, MD, MSc, FRCPC | University of Alberta, Edmonton, Ala |
| Kamen Vlassakov, MD | Brigham and Women's Hospital, Boston, Mass |
| Lindsay Vokach-Brodsky, MD | Stanford University, Palo Alto, Calif |
| Gina Votta-Velis, MD, PhD | University of Illinois at Chicago, Chicago, Ill |
| Robert S. Weller, MD | Wake Forest University, Winston-Salem, ND |
| Mary J. Hargett, BS Group Administrator Hospital for Special Surgery New York, NY | |

APPENDIX 2. Associate Faculty and Interested Colleagues, 2010

| Associate Faculty | Institution |
|--------------------------------------|--|
| Brenden Carvalho, MB, ChB | Stanford University, Palo Alto, Calif |
| Laura Clark, MD | University of Louisville, Louisville, Ky |
| Harold Gelfand, MD | Johns Hopkins University, Baltimore, Md |
| J. C. Gerancher, MD | Wake Forest University, Winston-Salem, NC |
| Helmut R. Gerber, MD | Kantonsspital, Lucerne, Switzerland |
| James R. Hebl, MD | Mayo Clinic College of Medicine, Rochester, Minn |
| Veerandara Koyyalamudi, MD, MRCS(Ed) | University of Florida, Gainesville, Fla |
| John Laur, MD | University of Iowa, Iowa City, Iowa |
| Gregory A. Liguori, MD | Hospital for Special Surgery, New York, NY |
| Joseph M. Neal, MD | Virginia Mason Medical Center, Seattle, Wash |
| Beverly Pearce-Smith, MD | University of Pittsburgh, Pittsburgh, Pa |
| Brian Williams, MD | University of Pittsburgh, Pittsburgh, Pa |
| Paul Willoughby, MD | State University of New York, Stony Brook, NY |
| Christopher L. Wu, MD | Johns Hopkins University, Baltimore, Md |