# Designing and Implementing a Comprehensive Learner-Centered Regional Anesthesia Curriculum

Hugh M. Smith, MD, PhD, Sandra L. Kopp, MD, Adam K. Jacob, MD, Laurence C. Torsher, MD, and James R. Hebl, MD

(Reg Anesth Pain Med 2009;34: 88-94)

ducation experts have suggested that many doctors know  $\mathbf{E}^{\text{ducation}}$  experts have suggested that the statement what to teach, but few know how to teach.<sup>1</sup> This statement stems from the fact that most physicians do not receive formal instruction in education theory or methodology during their own medical training. As a result, apprenticeship models of education have prevailed as the primary mode of teaching regional anesthesia to residents in-training for the past several decades. Limitations to this style of teaching include inconsistent learning experiences and limited case numbers. Recently, Richman et al<sup>2</sup> demonstrated that a dedicated regional anesthesia rotation may increase the number of blocks performed by residents by concentrating their learning experiences into a focused period. Although this approach represents an educational step forward, most regional anesthesia curricula continue to revolve around an apprenticeship style of training. The Accreditation Council for Graduate Medical Education (ACGME) has also made attempts to improve resident education by implementing standardized education performance objectives (ie, competencies) and establishing minimum regional block numbers for anesthesia residents during the past decade (for complete explanation of ACGME competencies, see http://www.acgme.org/acWebsite/ home/home.asp). However, it has been estimated that 40% of residents lack adequate exposure or proficiency in peripheral nerve blockade.<sup>3,4</sup> Finally, the introduction of ultrasound-guided regional anesthesia (UGRA) and the national spotlight on patient safety and quality care initiatives have introduced new challenges for regional anesthesia educators. In an effort to address these and many other concerns, we recently redesigned and implemented a new regional anesthesia curriculum within our institution. This curriculum-which describes a single institution's approach to resident education-is reviewed within this special article.

# **CURRICULUM OBJECTIVES**

The primary goal of our curriculum is to train safe, competent practitioners of regional anesthesia by combining traditional patient care experiences with learner-centered activ-

From the Department of Anesthesiology, Mayo Clinic College of Medicine, Rochester, MN.

Accepted for publication September 6, 2008.

ISSN: 1098-7339

DOI: 10.1097/AAP.0b013e31819e734f

ities within a unique educational environment. The curriculum is intended to maximize each resident's ability to achieve technical and clinical proficiency with a variety of traditional and ultrasound-guided regional anesthetic techniques, understand the core principles and concepts of regional anesthesia and acute pain medicine, and identify the role of regional anesthesia in the management of surgical patients. The primary educational objectives of the curriculum include the following:

- Standardizing educational content. Educational content has been standardized by developing performance guidelines that establish standards and criteria expected of residents while caring for patients (Table 1). These established guidelines—in addition to Internet-based learning modules and other curricular elements—provide uniformity in the delivery and availability of educational content.
- Quality care and patient safety. Several studies have demonstrated that training in a simulated environment before patient encounters can improve procedural efficiency, decrease error rates, and potentially impact quality of care and patient safety.<sup>5–8</sup> As a result, we have integrated a comprehensive "preclinical" educational program for UGRA into our curriculum to maximize the educational value of each regional experience. Therefore, the classic dictum of apprenticeship models of learning—"see one, do one, teach one"—has been replaced with "see one, practice one, do one."
- Resident evaluation and improvement. Formal evaluation of residents, staff, and program performance is critical to the process of improving education. Faculty members discuss resident performance, including knowledge base, clinical judgment, technical skills, patient rapport, professional interaction with allied health staff, organizational skills, and learning deficiencies, on a monthly basis during prescheduled division meetings. A designated faculty member personally discusses the evaluation with each resident before receiving a written evaluation and summary of comments. Residents complete a confidential evaluation on each faculty member and the regional anesthesia rotation at the completion of their 8-week experience. Individual faculty members review their resident comments with the department chair on an annual basis. The regional anesthesia coordinator receives anonymous resident feedback on the rotation from the residency program director every 6 months.

### CURRICULUM DESIGN

The newly designed regional anesthesia curriculum is an 8-week rotation assigned to residents late in their CA-2 year (January to June) or during their CA-3 year of training. Three anesthesia residents are assigned to the 8-week rotation every cycle. In an effort to develop proficiency with both traditional and ultrasound-guided regional techniques, standardize learning experiences, and allow continuous feedback from faculty

Address correspondence to: Hugh M. Smith, MD, PhD, Department of Anesthesiology, Mayo Clinic, 200 First St SW, Rochester, MN 55905 (e-mail: smith.hugh2@mayo.edu).

Copyright © 2009 by American Society of Regional Anesthesia and Pain Medicine

Clinical Element	Resident Performance					
Anesthesia preconsultation	Review patient history and relevant laboratory data					
	Determine intraoperative anesthesia requirements					
	<ul> <li>Understand comorbidities and implications</li> </ul>					
	<ul> <li>Identify possible regional anesthesia indications and contraindications</li> </ul>					
	• Ensure that informed consent for anesthetic is complete					
	Order appropriate premedications					
Patient identification procedures (universal protocol)	Identify patient using 2 distinct patient identifiers					
	Confirm correct surgical procedure and site					
	· Identify and initial the correct regional anesthesia site					
	Perform procedural pause after prep and drape					
Sterile technique	Remove jewelry					
	Wash hands with appropriate antiseptic solution					
	Wear mask and sterile gloves					
	• Proper set-up and preparation of regional tray					
	• Sterile prep and drape of the regional anesthesia site					
	Maintain sterile technique throughout					
Regional technique	• Attend to patient comfort with appropriate sedation					
	<ul> <li>Select appropriate drugs and doses</li> </ul>					
	Position patient appropriately					
	<ul> <li>Identify and mark superficial landmarks</li> </ul>					
	· Perform local anesthetic skin wheal at needle insertion site					
	Redirect needle appropriately					
	<ul> <li>Respond appropriately to potential indicators of nerve injury</li> </ul>					
Monitoring	Obtain pre-procedural vital signs					
	• Monitor for signs and symptoms of local anesthetic toxicity, oversedation, comfort, and block efficacy					
Documentation	· Complete appropriate procedural charting and orders					
	Document all administered medications					
	• Perform appropriate documentation during postoperative rounds					

T	А	В	LI	E	1	Perf	form	nan	ce	Che	ckl	list	for	Reg	iiona	LA	Anest	hesia	Pro	bced	ures

members, the regional anesthesia rotation was expanded to 2 consecutive months. Previously, the rotation was a 4-week clinical experience occurring at any point during a trainee's residency (CA-1, CA-2, or CA-3 year).

The regional anesthesia curriculum is summarized in a resident orientation manual that is distributed to residents several weeks before the rotation. It includes educational objectives, clinical expectations (Table 2), and a suggested reading list. Formal clinical responsibilities are not assigned on the first day of the rotation to ensure that residents are available to discuss performance expectations, clinical duties, ultrasound training, emergency protocols, documentation requirements, schedules, and available learning resources.

In addition to the technical aspects of regional anesthesia, residents are encouraged to develop broader patient management skills through exposure to clinical responsibilities during all phases of patient management (Table 2). To facilitate this, residents are assigned with a faculty member to cover 2 orthopedic operating rooms on a daily basis. Each resident is expected to develop a preoperative, intraoperative, and postoperative care plan for all patients assigned to their rooms. This scheduling system allows residents to participate in patient evaluation (ie, understanding the indications, contraindications, and limitation of regional blockade), induction and airway management (if applicable), vascular access, monitoring, intraoperative sedation, and the postoperative management for each patient in addition to the clinically appropriate regional anesthetic technique(s).

Historically, our program has not assigned regional residents (CA-2 or CA-3) to operating rooms in which the inroom provider was a CA-1 resident. Under these circumstances, the CA-1 resident would perform all regional procedures (neuraxial and peripheral blockade) taking place within their operating room on a given day. However, in an effort to maximize resident exposure to regional techniques during their focused 8-week experience, the redesigned curriculum may now have regional residents covering an operating room in which the in-room provider is a CA-1 resident. Under these circumstances, the CA-1 resident will perform only neuraxial procedures assigned to their room. All peripheral nerve blocks (singleinjection and continuous catheter techniques) are performed by the regional resident assigned to the room. This change in practice accomplishes 3 things: (1) it permits the relatively inexperienced CA-1 resident to focus on the more fundamental aspects of anesthesia while also observing peripheral nerve blocks; (2) it increases the regional residents' peripheral nerve block experience during their focused 8-week regional anesthesia rotation; and (3) it allows regional residents to function in the role of a teacher while explaining the indications, contraindications, anatomy, technique, and complications of various regional blocks to their junior colleagues-who may better learn without the pressure of performing the procedure itself. During the 8-week regional experience, residents generally perform more than 180 peripheral nerve blocks (single-injection and continuous catheter techniques), including interscalene,

**TABLE 2.** Clinical Expectations During the Regional

 Anesthesia Rotation

# **Preoperative Care**

Review patient history and relevant laboratory data Complete a physical examination

- Appropriate preoperative neurologic evaluation
- Develop an anesthetic plan with the patient
  - · Understand impact of comorbid conditions
  - · Select appropriate regional technique
- Discuss risks, benefits, and alternatives of anesthetic options Order preoperative analgesic medications

Discuss the patient with the attending anesthesiologist

Perform the appropriate regional procedure(s) under direct supervision

#### **Intraoperative Care**

Evaluate the block before surgical incision

- Develop an approach to managing failed blocks
  - · Block supplementation (if indicated or appropriate)
- Conversion to general anesthesia
- · Appropriate use of supplemental opioids and sedation

## **Postoperative Care**

- Manage patient in the postanesthesia care unit
  - · Appropriately assess and manage pain
  - Perform postoperative regional techniques (if applicable)
  - Manage acute postoperative issues (eg, nausea and vomiting, perineural catheters)
- Participate in acute pain service rounds
  - Evaluate the efficacy of the regional techniques used
  - Adjust postoperative analgesics as needed
  - · Monitor patients for potential complications

supraclavicular, infraclavicular, axillary, peripheral upper extremity, posterior lumbar plexus, femoral, sciatic, popliteal, saphenous, and ankle blockade.

#### A LEARNER-CENTERED TRAINING MODEL

In the past, our apprenticeship model of training simply centered on maximizing the number of regional procedures each resident performed. Although performing regional techniques remain an essential component of the newly designed curriculum, additional modalities of learning have been introduced in a learner-centered style for the first time. Learner-centered activities are those educational tasks that require self-directed knowledge and skill development—shifting the focus from *faculty* to *resident* and from what is being *taught* to what is being *learned*. Recently incorporated learner-centered activities include an UGRA curriculum, simulation training, Internet-based e-learning modules, cadaveric dissection, journal club presentations, simulation software, audiovisual procedural manuals, and teaching responsibilities.

# **Ultrasound-Guided Regional Anesthesia**

Ultrasound-guided regional anesthesia is an important and rapidly evolving area of modern clinical practice. Advocates of UGRA suggest that technology may increase block efficacy, prolong duration, shorten block performance times, and improve patient safety when compared with other forms of neural localization.<sup>9–12</sup> The ultrasound curriculum is introduced during week 5 of the 2-month rotation and includes a series of

interactive sessions that facilitate proficiency, integration, and understanding of the 3 primary components of UGRA: (1) ultrasound physics and equipment, (2) scanning techniques and sonoanatomy, and (3) sonographic needle guidance. Ultrasound is considered to be an important method of neural localization. However, it is not the *only* modality taught to residents and fellows. Traditional techniques of regional anesthesia and neural localization (eg, paresthesia seeking, peripheral nerve stimulation, loss of resistance) are emphasized during the initial 4 weeks of the rotation.

An often unappreciated benefit of ultrasonography is its ability to enhance regional anesthesia education. Because an important objective of the regional curriculum is to maximize learning opportunities, the use of ultrasound has been integrated into activities outside UGRA. For example, ultrasonography is first used during the rotation as an educational tool to reinforce the relationship between surface landmarks and neurovascular anatomy. While performing traditional regional techniques (eg, interscalene or axillary blockade), residents are encouraged to evaluate surface landmarks before the block technique, as well as assess local anesthetic distribution after performing the block. Familiarity with traditional techniques is still encouraged for those situations in which ultrasound equipment is unavailable, image quality is poor (eg, obese body habitus), or in which the selected block technique (eg, posterior lumbar plexus blockade) may not benefit from UGRA.

# Ultrasound Session 1: Ultrasound Physics and Equipment

The fundamental physics and theoretical principles of ultrasonography are important concepts for residents and fellows to fully understand. These concepts are introduced during didactic sessions and reinforced while residents perform live scanning and practice image acquisition on one another. The properties of wavelength, frequency, and amplitude are discussed in the context of wave formation, propagation, and attenuation, focusing on the reciprocal relationship between frequency and penetration. These topics are further reinforced during monthly "hands-on" clinical skills training sessions that use different ultrasound machines to acquire images and illustrate how the adjustment of gain, depth, and frequency can alter the overall image quality. Machine features such as ergonomic design, transducer availability, manufacturer presets, and data management are also compared and contrasted on various machine models.

# Ultrasound Session 2: Scanning Techniques and Sonoanatomy

After residents have become familiar with the principles of ultrasonography, the focus of the curriculum shifts to scanning techniques and sonoanatomy. Residents are first taught the 5 common transducer movements: sliding, angling, tilting, rotation, and pressure. These movements are practiced extensively on human and phantom gel models, drawing attention to the importance of fine motor control and comfortable ergonomics. While practicing these skills, the appearance of common anatomic structures such as nerve, muscle, bone, vessels, and fascia is highlighted. Specifically, the appearance of each structure is explained in the context of how its tissue properties interact with ultrasound waves. Residents then scan themselves and their colleagues to become familiar with upper and lower extremity sonoanatomy, tracing the brachial plexus from the roots to the peripheral branches and identifying the tibial and peroneal components of the sciatic nerve at the level of the

popliteal fossa. Residents are taught to enhance their image acquisition skills by adjusting the features learned in session 1 (gain, depth, frequency, and Doppler features) to optimize the appearance of relevant structures. Anatomic variants and ultrasound artifacts (shadowing, enhancement, reverberation) are also identified and described throughout the training session.

#### **Ultrasound Session 3: Sonographic Needle Guidance**

The final preclinical ultrasound session emphasizes sonographic needle guidance. During a "hands-on" clinical skills workshop session, residents use phantom gel models to apply the scanning techniques learned in session 2 to identify simulated neurovascular targets and practice needle-to-nerve approximation. Both in-plane and out-of-plane techniques (with both rightand left-handed needle guidance) are practiced to appreciate the advantages and disadvantages of each technique. Finally, ultrasound probe preparation (aseptic gel and transducer sleeve placement) and an understanding of how sleeve wrinkles or inadequate gel contact can degrade image quality are reviewed.

# Ultrasound Session 4: Demonstration of Ultrasound Proficiency

The ultrasound skills learned in each session are introduced in a progressive manner, such that complex skills and understanding build on simpler concepts. In an effort to maximize patient safety and quality care, residents are required to demonstrate ultrasound proficiency before performing these techniques in clinical practice. Each resident undergoes a standardized technical skills assessment during an UGRA simulation session using phantom gel models. During this assessment, residents must demonstrate a satisfactory understanding of the principles of ultrasonography, ultrasound equipment, image acquisition, sonoanatomy, and needle control. A standardized UGRA proficiency checklist is used to asses the integration and application of the educational content taught within the ultrasound curriculum. Residents are expected to perform specific tasks within each of the 3 component areas: ultrasound equipment, scanning and sonoanatomy, and needle guidance (Table 3). Upon satisfactory completion of the assessment, the UGRA proficiency checklist is placed within the resident's ACGME competency portfolio.

# **Simulation Education**

Simulation education improves physician training and patient safety by exposing residents to high-fidelity preclinical experiences using advanced technology.<sup>13–16</sup> Simulation training represents ideal learner-centered education where trainees face challenging clinical scenarios followed by debriefing sessions in which aspects of their management are reviewed and evaluated. During the first month of their regional anesthesia rotation, residents participate in a 3-hr simulation session at the Mayo Clinic Multidisciplinary Simulation Center. During this time, residents perform both leadership and supportive roles during the management of a variety of regional anesthetic emergencies-including a high spinal, local anesthetic toxicity (seizure and cardiac arrest), oversedation and respiratory arrest, and myocardial ischemia from epinephrine uptake. The faculty educator is responsible for providing a safe learning environment where residents can describe and analyze their own emotional reactions, decision-making skills, and overall

Ultrasound-Guided Regional Anesthesia Element	Resident Performance					
Ultrasound equipment	Navigate to patient demographic screen					
	• Input appropriate patient data					
	Navigate to imaging screen					
	• Select appropriate probe and frequency for application					
	Adjust depth, gain, contrast to optimize image					
	Capture appropriate image for medical record documentation					
	Navigate to "End Exam" screen					
	Store image for medical record documentation					
Scanning techniques and sonoanatomy	Hold and orient probe correctly					
	Perform basic probe movements					
	• Use appropriate gel and probe pressure while scanning					
	Recognize basic image artifacts					
	• Distinguish the sonographic appearance of artery, vein, bone, muscle, and nerve					
	<ul> <li>Identify the relevant neuroanatomy for interscalene, supraclavicular, infraclavicular, and axillary brachial plexus blockade</li> </ul>					
	<ul> <li>Identify and trace upper extremity peripheral nerves</li> </ul>					
	<ul> <li>Identify the sciatic nerve within the popliteal fossa</li> </ul>					
	<ul> <li>Identify the tibial nerve above the medial malleolus</li> </ul>					
Sonographic needle guidance	• Demonstrate appropriate hand positions for the probe and the needle					
	• Demonstrate in-plane and out-of-plane needle-to-probe orientation					
	<ul> <li>Identify simulated phantom target and needle insertion location</li> </ul>					
	<ul> <li>Adjust needle depth and trajectory to approximate target</li> </ul>					
	· Demonstrate basic techniques for optimizing needle visualization					
	• Maintain needle and target imaging >80% of the time during simulation					
	Advance needle only when visualized					

© 2009 American Society of Regional Anesthesia and Pain Medicine

<b>TABLE 4.</b> Learner-Centered Curricular Components and           ACGME Competencies

	ACGME
Curriculum Component	Competency
Ultrasound education	
Ultrasound physics and equipment	MK
Scanning technique and sonoanatomy	MK
Sonographic needle guidance	PC, MK
Simulation education	
Develops differential diagnosis of problem	PC, MK
Demonstrates resuscitation skills	PC
Crew resource management/teamwork	IC, Pr
Postscenario debriefing	IC, PBL
Anatomy laboratory	
Guided dissection	MK, Pr
Clinical correlation to regional techniques	MK, PC
Multimedia resources	
Interactive simulation software	PC, MK, PBL
Mayo Clinic procedural training video	PC, MK, PBL
E-learning	
Web-based learning modules (in development)	MK, SBP, PBI
Online problem-based learning (in development)	IC, PBL
Teaching responsibilities	
Teaches junior residents and medical students clinical case management	PC, MK, IC, PBL, Pr
Journal club	
Identifies topic and completes literature search	MK, PBL
Critically appraises topic and presents summary	IC, PBL

Abbreviations: PC, patient care; MK, medical knowledge; PBL, practice-based learning and environment; IC, interpersonal and communication skills; Pr, professionalism; SBP, system-based practice.

performance during the scenario. Simulation sessions foster the development of several clinical skills that fulfill associated ACGME competencies (Table 4). These simulation sessions have directly contributed to successful clinical outcomes within our own practice.<sup>8</sup>

#### **Cadaveric Dissection**

Regional anesthesia is the practice of applied anatomy. Therefore, cadaveric dissection in the anatomy laboratory is an important and integral part of the regional anesthesia curriculum. Throughout the 8-week rotation, regional anesthesia residents and fellows complete focused dissections of the brachial plexus, lumbosacral plexus, sciatic, and femoral nerves during dedicated afternoon sessions. This allows trainees to review and correlate relevant anatomy with regional anesthesia techniques, surface anatomy, and sonoanatomy. Although faculty from the Department of Anatomy are readily available for questions and support, this activity epitomizes learnercentered education as trainees complete and review dissections in a self-directed manner throughout the rotation. Residents and fellows have reported significant utility associated with anatomic review and acquiring a better understanding of regional anesthetic techniques.

# **Multimedia Resources**

Simulation software offers residents an interactive and directly applicable virtual learning experience. Residents have the opportunity to use both upper and lower extremity regional anesthesia simulation software during the 8-week rotation. In particular, interactive DVDs<sup>17</sup> are provided that enable learners to watch tutorials, review regional anatomy, and perform virtual computer-based regional anesthesia techniques. An advanced feature of this software is the ability to remove layers of human anatomy in sequence (from superficial to deep) after successful neural localization to reveal needle-to-nerve proximity and the corresponding relationship with surrounding vascular and bony anatomy. Residents are also expected to review procedural training videos<sup>18</sup> that provide visual tutorials of perioperative regional anesthesia and analgesia techniques. These and other resources provide residents with self-directed learning opportunities while fulfilling several ACGME competencies (Table 4).

# E-learning

Internet-based education for the regional anesthesia rotation is currently being developed and is expected to play an important role within the curriculum. The Department of Anesthesiology is in the process of creating an extensive series of Blackboard Vista Web-based learning modules that cover several core regional anesthesia topics and procedures. Advantages of an online residency curriculum include (1) standardization of content, (2) utilization of interactive multimedia technologies, (3) providing a learning progression of increasingly complex topics, and (4) individualized delivery of course material.<sup>19–21</sup> Standardizing the quality of the content will also ensure that every resident is exposed to a similar "core knowledge." As a complement to this, individualized handson (ie, "tips and pearls") and didactic instruction is also provided by attending anesthesiologists on a case-by-case basis. Online coursework assessment tools can be used to evaluate both resident knowledge as well as the program's ability to achieve educational and institutional objectives (Table 4).

#### Journal Club

Regional residents coordinate and conduct a Regional Anesthesia Journal Club session during the final week of their rotation. Each resident is assigned a faculty mentor with whom he/she selects either a recent journal article or regional anesthesia topic of interest. Residents are expected to perform an evidence-based critical appraisal of the topic before presenting their conclusions to an audience of faculty and peers (Table 4).

#### **Teaching Responsibilities**

Substantial evidence supports the notion that learning and academic performance are increased when residents participate in teaching activities.<sup>22,23</sup> Functioning as "subconsultants," regional anesthesia residents are expected to teach junior (CA-1) residents and medical students during the 8-week rotation. The role of resident-as-teacher forces them to examine their command of the subject matter and ability to communicate relevant concepts and topics to new learners. Teaching responsibilities also address several important competencies identified by the residency training program (Table 4).

# DISCUSSION

Medical education in the United States has evolved over the past century from an apprenticeship model of learning to its current state of competency-based resident training. During this time, the practice of regional anesthesia has also evolved—from

© 2009 American Society of Regional Anesthesia and Pain Medicine

a period of "clicks and pops" and paresthesias to stimulating catheters and ultrasound guidance. Clearly, as the practice of regional anesthesia continues to evolve, so must residency programs to ensure that future clinicians are competent, welltrained, and proficient practitioners of regional anesthesia. Recently, our residency program expanded its regional anesthesia curriculum and overall approach to resident education. Several learner-centered components were added to the curriculum, including a standardized UGRA curriculum, hands-on clinical workshops, simulated training sessions, cadaveric dissection, Internet-based e-learning modules, simulation software, audiovisual procedural manuals, and teaching responsibilities. This special report was designed to outline our recently modified curriculum—recognizing that this model of learning represents a single institution's approach to resident education.

The curriculum described above has been fully developed and implemented within our institution. However, it has not been objectively validated or shown to improve resident education. It currently exists as a prototype-a foundation on which to build future learning opportunities. Despite the fact that most of the curricular components may not be new or innovative, their collective description and application to regional anesthesia represent a novel approach to regional anesthesia training. The curriculum integrates ultrasound education and learner-centered components that emphasize preprocedural training and simulation as a potential mechanism for improving patient safety and quality care. Although outcome metrics and program validation are needed, initial resident feedback suggests that the curriculum changes are having a positive effect. For example, based on formal resident evaluations, our trainees have noted that the rotation "...provides an abundant opportunity to perform peripheral nerve blockade... offers consistent, high quality teaching, and autonomy... [and] introduces ultrasound-guided regional anesthesia in a comprehensive and easy-to-understand format." Other residents have stated that their 8-week regional experience was the "best rotation of the residency." Finally, several residents have praised the "balanced curriculum and outstanding learning opportunities." Clearly, these comments are subjective and anecdotal. However, the responses suggest that the curriculum is having a strong and positive impact on resident education.

Implementation of the redesigned curriculum was initially met with several barriers and logistic challenges. The most significant challenge was overcoming the status quo. Some faculty argued that the previous curriculum must be meeting appropriate academic objectives, as our residents have consistently performed well on both written and oral board examinations. The remedy to this challenge involved redefining residency educational objectives, empowering educators with enthusiasm and vision to challenge the existing paradigm, and including the faculty in the curriculum redesign. A second challenge was convincing faculty to embrace new styles of teaching-moving away from apprenticeship models and toward learner-centered methods of education. Educators feel most comfortable teaching in the styles of their own instructors. Therefore, educating faculty members on modern education theory, effective teaching strategies, adult-learning styles, and barriers to education is a critical step to overcoming this obstacle. Finally, one of the most difficult barriers to conquer was acquiring the necessary time and resources throughout the development and redesign phase of the curriculum. Important solutions to this barrier include (1) recognizing that curriculum development will be labor-intensive, (2) clearly defining curriculum objectives and steps toward development, (3) dividing the labor among dedicated educators within the

department, and (4) acquiring the support of departmental leadership. Networking with other educators within the institution may also be beneficial, particularly those who have previous experience in curriculum redesign.

In summary, future advances in regional anesthesia and acute pain medicine will be highly dependent on the quality of regional anesthesia training over the next decade. Identifying metrics that accurately and reliably evaluate the adult learner, curricula, educational models, and quality care are important and interrelated objectives that need to be critically appraised and examined in future studies. Clearly, the identification and standardization of an "optimal" regional anesthesia curriculum are a larger issue that cannot be answered by one institution. However, we hope that this curriculum may serve as a building block for future study and discussion on the topic. Several important questions remain. For example, (1) What should the "standard of care" for regional anesthesia be during the next decade? (2) What are the competencies involved in such a practice? (3) How should curricula be critically appraised? (4) Can validated modern education theories be appropriately applied to regional anesthesia training? (5) How can programs implement new curricula in the setting of decreased funding and limited staffing? These questions need to be carefully reviewed and evaluated by regional anesthesia educators-as well as the regional anesthesia community at large.

#### REFERENCES

- MacDougall J, Drummond MJ. The development of medical teachers: an enquiry into the learning histories of 10 experienced medical teachers. *Med Educ*. 2005;39:1213–1220.
- Richman JM, Stearns JD, Rowlingson AJ, Wu CL, McFarland EG. The introduction of a regional anesthesia rotation: effect on resident education and operating room efficiency. *J Clin Anesth.* 2006;18: 240–241.
- Kopacz DJ, Neal JM. Regional anesthesia and pain medicine: residency training—the year 2000. *Reg Anesth Pain Med.* 2002;27:9–14.
- Smith MP, Sprung J, Zura A, Mascha E, Tetzlaff JE. A survey of exposure to regional anesthesia techniques in American anesthesia residency training programs. *Reg Anesth Pain Med.* 1999;24:11–16.
- Cohen J, Cohen SA, Vora KC, Xue X, Burdick JS, Bank S, et al. Multicenter, randomized, controlled trial of virtual-reality simulator training in acquisition of competency in colonoscopy. *Gastrointest Endosc.* 2006;64:361–368.
- Sites BD, Gallagher JD, Cravero J, Lundberg J, Blike G. The learning curve associated with a simulated ultrasound-guided interventional task by inexperienced anesthesia residents. *Reg Anesth Pain Med*. 2004;29:544–548.
- Sedlack RE, Kolars JC, Alexander JA. Computer simulation training enhances patient comfort during endoscopy. *Clin Gastroenterol Hepatol.* 2004;2:348–352.
- Smith H, Jacob A, Segura L, Dilger J, Torsher L. Simulation education in anesthesia training: a case report of successful resuscitation of bupivacaine-induced cardiac arrest linked to recent simulation training. *Anesth Analg.* 2008;106:1581–1584.
- Orebaugh SL, Williams BA, Kentor ML. Ultrasound guidance with nerve stimulation reduces the time necessary for resident peripheral nerve blockade. *Reg Anesth Pain Med.* 2007;32:448–454.
- Hopkins PM. Ultrasound guidance as a gold standard in regional anaesthesia. Br J Anaesth. 2007;98:299–301.
- Chan VW, Perlas A, McCartney CJ, Brull R, Xu D, Abbas S. Ultrasound guidance improves success rate of axillary brachial plexus block. *Can J Anaesth.* 2007;54:176–182.
- 12. Willschke H, Marhofer P, Bosenberg A, Johnston S, Wanzel O,

© 2009 American Society of Regional Anesthesia and Pain Medicine

Cox SG, et al. Ultrasonography for ilioinguinal/iliohypogastric nerve blocks in children. Br J Anaesth. 2005;95:226–230.

- Cumin D, Merry AF. Simulators for use in anaesthesia. *Anaesthesia*. 2007;62:151–162.
- Eich C, Timmermann A, Russo SG, Nickel EA, McFadzean J, Rowney D, et al. Simulator-based training in paediatric anaesthesia and emergency medicine—thrills, skills and attitudes. *Br J Anaesth*. 2007;98:417–419.
- Russo SG, Eich C, Barwing J, Nickel EA, Braun U, Graf BM, et al. Self-reported changes in attitude and behavior after attending a simulation-aided airway management course. *J Clin Anesth*. 2007;19:517–522.
- Zausig YA, Bayer Y, Hacke N, Sinner B, Zink W, Grube C, et al. Simulation as an additional tool for investigating the performance of standard operating procedures in anaesthesia. *Br J Anaesth*. 2007;99:673–678.
- 17. Delbos A, Eisenach JC, Albert NT, Narchi P, Singelyn F, Brasseur L.

Peripheral Nerve Blocks on DVD: Upper and Lower Limbs. Philadelphia: Lippincott, Williams, & Wilkins; 2004.

- Lennon RL, Horlocker TT. Mayo Clinic Analgesic Pathway and Procedural Training Manual [on DVD]. New York: Informa HealthCare; 2006.
- Cook DA. Learning and cognitive styles in Web-based learning: theory, evidence, and application. *Acad Med.* 2005;80:266–278.
- 20. Cook DA. Web-based learning: pros, cons and controversies. *Clin Med.* 2007;7:37–42.
- Cook DA, Dupras DM. A practical guide to developing effective Web-based learning. J Gen Intern Med. 2004;19:698–707.
- Busari JO, Scherpbier AJ. Why residents should teach: a literature review. J Postgrad Med. 2004;50:205–210.
- Thomas PS, Harris P, Rendina N, Keogh G. Residents as teachers: outcomes of a brief training programme. *Educ Health (Abingdon)*. 2002;15:71–78.