The American Society of Regional Anesthesia and Pain Medicine, the European Society of Regional Anaesthesia and Pain Therapy, and the Asian Australasian Federation of Pain Societies Joint Committee Recommendations for Education and Training in Ultrasound-Guided Interventional Pain Procedures

Samer N. Narouze, MD, PhD, David Provenzano, MD,† Philip Peng, MBBS, FRCPC,‡ Urs Eichenberger, MD,§ Sang Chul Lee, MD, PhD,¶ Barry Nicholls, MD,|| and Bernhard Moriggl, MD, FIACA***

Abstract: The use of ultrasound in pain medicine for interventional axial, nonaxial, and musculoskeletal pain procedures is rapidly evolving and growing. Because of the lack of specialty-specific guidelines for ultrasonography in pain medicine, an international collaborative effort consisting of members of the Special Interest Group on Ultrasonography in Pain Medicine from the American Society of Regional Anesthesia and Pain Medicine, the European Society of Regional Anaesthesia and Pain Therapy, and the Asian Australasian Federation of Pain Societies developed the following recommendations for education and training in ultrasound-guided interventional pain procedures. The purpose of these recommendations is to define the required skills for performing ultrasound-guided pain procedures, the processes for appropriate education, and training and quality improvement. Training algorithms are outlined for practice- and fellowship-based pathways. The previously published American Society of Regional Anesthesia and Pain Medicine and European Society of Regional Anaesthesia and Pain Therapy education and teaching recommendations for ultrasound-guided regional anesthesia served as a foundation for the pain medicine recommendations. Although the decision to grant ultrasound privileges occurs at the institutional level, the committee recommends that the training guidelines outlined in this document serve as the foundation for educational training and the advancement of the practice of ultrasonography in pain medicine.

(*Reg Anesth Pain Med* 2012;37: 657–664)

From the *Center for Pain Medicine, Summa Western Reserve Hospital, Cuyahoga Falls, OH; †Institute for Pain Diagnostics and Care, Ohio Valley General Hospital, McKees Rocks, PA; ‡Department of Anesthesia and Pain Management, University Health Network, University of Toronto, Toronto, Ontario, Canada; §Department of Anesthesiology, Intensive care and Pain Therapy, Clinic St Anna, Lucerne, Switzerland; ¶Department of Anesthesiology and Pain Medicine Seoul National University Hospital Seoul National University College of Medicine Seoul, Korea; ||Department of Anaesthesia and Pain Management, Musgrove Park Hospital, Taunton, Somerset, UK; and **Department of Anatomy, Histology, and Embryology, Innsbruck Medical University, Innsbruck, Austria.

Accepted for publication July 10, 2012.

Address correspondence to: Samer Narouze, MD, PhD, Center for Pain Medicine, Summa Western Reserve Hospital, 199 23rd St., Cuyahoga Falls, OH, 44223 (e-mail: narouzs@hotmail.com).

This study was not supported by any grants or by any manufacturer or third-party research funding.

ISSN: 1098-7339
DOI: 10.1097/AAP.0b013e318269c189

Ultrasonography in pain medicine (USPM) is a rapidly growing medical field in interventional pain management, as evidenced by the remarkable increase in the publication of literature on ultrasound-guided injections and by the growing number of workshops offered at large national and international meetings.[1–5] Traditionally, axial, nonaxial, and musculoskeletal (MSK) interventional pain procedures have been performed with either landmark or image-guided techniques, including fluoroscopy and computed tomography.

Increased use of ultrasound for interventional pain procedures has originated from specific visual and procedural benefits, including the ability to (1) visualize soft tissues, including muscle layers, nerves, and blood vessels; (2) visualize real-time needle advancement; and (3) reduce radiation exposure to both the patient and health care provider.[1,2]

Recognizing the rapid growth in the clinical use of ultrasound, the American Medical Association (AMA) drafted resolution 802 in 1999, stating that "the AMA affirms that ultrasound imaging is within the scope of practice of appropriately trained physicians."[6] In an effort to safely advance the progression of ultrasound in clinical medicine, the resolution recommended that medical fields utilizing ultrasound develop specialty-specific guidelines. Furthermore, the AMA recommends that hospitals grant ultrasound privileges based on the scope of practice defined in each specialty's guidelines. Multiple examples exist for ultrasound specialty-specific guidelines. For example, in 2001, the American College of Emergency Physicians approved comprehensive guidelines for the use of ultrasound in emergency medicine.[7] These guidelines were updated in 2008.[8] Another example includes the scope of practice and certification process established for anesthesiologists who use perioperative transesophageal echocardiography.[9] Recently, the recommendations for scope of practice for the use of ultrasound in regional anesthesia have been developed.[10] Musculoskeletal guidelines and course training recommendations have been published.[11,12] To date, no specialty-specific guidelines exist for USPM.

Because of the rapid growth in the use, research, and advancement of USPM, it is important to define the current scope of practice for USPM. Previously, Sites et al[10] developed specific recommendations for education and training in ultrasound-guided regional anesthesia (UGRA). This document should be viewed as an extension of those recommendations, which were previously published by the Joint Committee of the American Society of Regional Anesthesia and Pain Medicine (ASRA) and the European Society of Regional Anaesthesia and Pain Therapy

(ESRA) for education and training in UGRA. The curriculum presented here purposively follows and parallels the UGRA document. This intentional mirroring may be reflected in similarities in structure and textual descriptions between the 2 documents.

Beginning with the foundation developed by the ASRA and ESRA UGRA recommendations, members of 3 organizations initiated an international collaborative effort. Assigned pain physicians from the Special Interest Group on Ultrasonography in Pain Medicine from ASRA, ESRA, and the Asian Australasian Federation of Pain Societies developed the following recommendations to define the scope of best practice for USPM, the teaching curriculum, and the algorithms for the implementation of USPM into clinical practice. Committee members were selected based on clinical and research expertise in both the technical and educational components of USPM. Members included practitioners from both academic and private practice. An open forum was held at the November 18, 2011, ASRA Pain Medicine Meeting (New Orleans, Louisiana) to acquire input on the draft recommendations. Specifically, the objectives of the guidelines developed by this international collaborative effort are as follows:

1. Describe the core tasks, competencies, and skills required when performing an ultrasound-guided pain procedure.
2. Define and develop a process for the proper education and training in USPM for established practitioners, residents, and fellows.
3. Recommend the establishment of a quality improvement process that encourages and advances the integration of USPM into clinical practice.

The target audience for these guidelines is all physicians performing USPM. The recommendations will provide a framework for educators, practicing pain physicians, and trainees interested in learning and implementing USPM.

Although these recommendations received unanimous agreement from ASRA/ESRA/Asian Australasian Federation of Pain Societies and committee members, it is important to recognize that evidence-based medicine is currently lacking for certain areas in USPM.[2] Therefore, some of the suggestions and recommendations in this document represent the opinions and clinical experience of the committee members. As the field of USPM matures and grows, these recommendations will need to be periodically reviewed and updated when appropriate, based on new clinical experience and research knowledge. As our knowledge level increases, some of the material presented here may require updating.

Indications and Scope of Practice

Ultrasonography in pain medicine is used to sonographically evaluate anatomic targets and to facilitate the performance of various pain procedures. Ultrasound allows for visualization of real-time needle advancement and soft tissue structures as well as bony surfaces without radiation exposure. Noninvasively, ultrasonography can identify individual typical and atypical anatomy and structural pathologies.[13,14] Furthermore, ultrasonography provides the unique opportunity to perform dynamic examination of the anatomic target.

Ultrasound-guided pain procedures are performed by pain physicians. The committee members identified the following tasks as helpful in performing an ultrasound-guided pain block. These tasks are not necessarily sequential and may not be appropriate for all block scenarios.

1. Maintain an aseptic technique, including transducer sterility, throughout the procedure (Appendix 1).
2. Perform a systematic scan that allows for the confirmation of normal anatomy and recognition of structural pathologies and anatomic variations.
3. Visualize key landmark structures, including nerves, blood vessels, pleura, muscles, tendons, fascia, and bone. Use the Doppler functions to identify vascular structures.
4. Identify the target on short-axis imaging (preferred) or long-axis imaging (if applicable).
5. Plan for a safe needle approach that avoids unnecessary tissue trauma or injury to other surrounding structures.
6. Follow the tip of the needle under real-time visualization as it advances toward the target.
7. Consider injecting an initial small volume of a test solution. If the solution is not visualized during injection, presume that the needle tip is either intravascular or out of the imaging plane.
8. Monitor the spread of the injectate under real-time visualization and make necessary needle adjustments if an undesired pattern of injectate spread is visualized. The visualization of the injectate should be monitored throughout the injection to avoid intravascular injection and to limit spread to nontargeted adjacent structures.
9. When performing MSK procedures, avoid intratendinous corticosteroid injections and needle damage to articular cartilage.
10. Maintain traditional safety guidelines, including the presence of standard monitoring and resuscitation equipment.
11. When applicable, consider a secondary confirmation technique, such as fluoroscopy.
12. Maintain appropriate ultrasound ergonomics.
13. Maintain appropriate documentation and image storage with an archival system (Appendix 2).

Contraindications

There are no known absolute contraindications to the use of ultrasound. With respect to safety, the US Food and Drug Administration has stated, "Even though there are no known risks, ultrasound energy heats the tissues and may have other biologic effects. It can also produce small pockets of gas in body fluids or tissues (cavitation). The long-term effects of tissue heating and cavitation are not known."[15] Doppler modes may result in higher exposure levels. The pain physician should limit and minimize the use of ultrasound to only the time necessary to perform each procedure.[16]

Procedures

Ultrasound had a wide variety of applications in interventional pain medicine, including peripheral, spinal or axial, and MSK applications (Table 1). The Joint Committee recognizes that there are different levels of difficulty for the various pain procedures (Tables 2A and 2B).

Characteristics that tend to increase the level of difficulty include the following:

a. deep blocks resulting in the degradation of both the ultrasound and needle image,
b. blocks that have the potential for serious complications (eg, unintentional intravascular injection, pneumothorax),
c. blocks that involve small nerves that are difficult to image, and
d. patient-related factors, such as obesity, degenerative, and arthritic changes.

Proficiency

Various skills are required to ensure an appropriately conducted ultrasound-guided pain procedure. These skills can be

TABLE 1. Common USPM Applications and Anatomic Targets

Peripheral Structure	Axial Structure	MSK Applications
Greater occipital nerve	Cervical–nerve root	Large joints injection
Stellate ganglion block	Cervical-TON	Intermediate joint
Intercostal nerves	Cervical–facet periarticular	Small joints
Suprascapular nerve	Cervical–medial branch	Joint aspiration
Iliohypogastric/ilioinguinal nerve/TAP block	Thoracic paravertebral block	Ligaments
Lateral femoral cutaneous nerve	Lumbar–medial branch	Peritendonous injections
Celiac plexus block	Lumbar–facet periarticular	Intramuscular/TPI/Botox
Inguinal canal block	SIJ-periarticular	Bursa injection
Pudendal nerve	Interlaminar epidural*	Fenestration/lavage
Other UE/LE peripheral nerves	Caudal and sacral foramina*	

*Refer to the Limitations section.

LE indicates lower extremity; SIJ, sacroiliac joint; TAP, transversus abdominis plane; TON, third occipital nerve; TPI, trigger point injection; UE, upper extremity.

divided into 4 major categories: (1) understanding ultrasound system operations, (2) image optimization, (3) image interpretation based on knowledge of sonoanatomy, and (4) visualization of needle insertion and the spread of the injectate. For each of these categories, the Joint Committee recognizes a defined skill set. These skill sets are explained in Table 3.

Training

Two pathways have been developed for USPM training. The first pathway, the practice-based pathway, has been designed to assist current practicing pain specialists with formal pain training who require additional education to become proficient and adequately educated in USPM. The second pathway, the fellowship-based pathway, has been developed to structure ultrasound education for graduate medical training and to develop criteria for fulfilling pain medicine training requirements. Both pathways will include didactics, practical hands-on training, competency assessment, and performance improvement. After completion of the appropriate pathways, steps must be taken to maintain clinical competency (cognitive and technical skills) through continuing medical education and sustained performance of ultrasound examinations and procedures. The committee has not provided

TABLE 2A. Assigned Level of Difficulty for Specific Ultrasound-Guided Pain Interventions

Peripheral structures	
Level I	GON (nuchal level), SSN, II/IH, peripheral nerves/neuroma
Level II	GON (C2 level), SGB, ICN, LFCN, inguinal canal block, pudendal
Level III	CPB
Axial structures	
Level I	SIJ-periarticular, caudal, sacral foramen
Level II	Cervical nerve root,* cervical facet periarticular, thoracic paravertebral, lumbar medial branch and facet periarticular, interlaminar epidural
Level III	Cervical-TON, cervical–medial branch
MSK	
Level I	Joints injection and aspiration, bursa, ligaments, intramuscular, and peritendinous injections
Level II	Fenestration and lavage
Level III	

The level of difficulty was appraised based on 4 criteria (list in Table 2B). The summation of the scores from these 4 criteria results in the summary score: level I (basic) is 4 to 6; level II (intermediate) is 7 to 9; and level III (advanced) is 10 to 12.

*Caution is advised when performing cervical nerve root blocks because of the potential for devastating complications. Some small blood vessels may escape ultrasound visualization.[20]

CPB indicates celiac plexus block; GON, greater occipital nerve block; ICN, intercostal nerve; LFCN, lateral femoral cutaneous nerve; SGB, stellate ganglion block; TON, third occipital nerve.

TABLE 2B. Scoring Criteria for the Level of Block Difficulty

For Each Block, the Total Score Based on the Following Criteria	
Ease of visualization of target structures	1 = Easy, 2 = intermediate, 3 = difficult
Ease of visualization of identifying structures	1 = Easy, 2 = intermediate, 3 = difficult
Technical performance of block	1 = Easy, 2 = intermediate, 3 = difficult
Risk of complication from associated structures	1 = Low, 2 = intermediate, 3 = high

TABLE 3. Required Skills for Ultrasound-Guided Pain Medicine Procedure Proficiency

Ultrasound System Operations	Image Optimization	Identification and Interpretation of Image	Procedural Technique
Frequency	Transducer selection	Define relevant anatomic structures	Standardization of image orientations
Depth and focus settings	Transducer pressure	Recognition of anatomic variations and structural pathologies	Transducer sterility
Gain and time gain compensation settings	"PART" transducer placement	Recognition of vascular structures	Appropriate ergonomics
B-mode	Dynamic imaging	Recognition of anatomic artifacts	In-plane needle insertion
Tissue harmonic imaging	Needle selection	Recognition of acoustic artifact	Out-of-plane needle insertion
Color Doppler		Selection of safe needle trajectory	Needle-tip identification
Power Doppler			Hydrolocalization
Image acquisition and storage			Monitoring injectate spread

PART indicates pressure, alignment, rotation, and tilting.
Adapted with modifications from Sites et al.[10]

specific recommendations for a minimum number of procedures for each technique that are required to achieve the appropriate level of competency. The minimum number of required procedures will depend on the complexity of the procedure and the individual's level of education and expertise. Research has suggested that technical success and competency improve with the total number of procedures performed and with the addition of different educational platforms, such as simulation training, to the medical instruction.[17,18] For ultrasound-guided sacroiliac joint injections, the successful intra-articular placement rate was shown to be low, with a technical success rate of only 60% during the first 30 injections.[17] When an additional 30 injections were performed, the intra-articular placement rate improved to 93.5%. Studies involving simulator training aids have also suggested that clinical success rates improve with simulation training and the total number of performed blocks.[18]

Practice Pathway Recommendations

The Joint Committee recognizes the existence of different practice patterns (ie, private vs academic), varying institutional processes for adopting new technology and techniques, and individual styles of learning. As such, several options are available for the established practitioner to begin to acquire the skill sets associated with USPM.

1. Participation in an accredited continuous medical education (CME) event in which the skill sets listed under the proficiency section are covered. It is recommended that these educational events include both didactic and hands-on experience of at least 16 hours' duration. The CME attendance should be in accordance with specialty and local guidelines. Additional educational resources are available, including Web-based training, video, lectures, textbooks, departmental conferences, review courses, self-study, preceptorships, and simulator-based programs. These materials can help supplement the information learned during the CME activity.
2. Practice ultrasound scanning techniques and learn sonoanatomy by imaging oneself and colleagues.
3. Practice needle insertion techniques using simulators, phantoms, and cadavers.
4. Whenever possible, spend time with experienced individuals, observing and learning techniques of USPM.
5. The Joint Committee recommends that the novice's initial clinical experience be mentored and supported by an individual experienced in USPM. When available at the physician's home institution, a USPM coordinator should be involved in the educational process. Appendix 3 defines the identification and the responsibilities of the USPM coordinator.

During the initial exposure to USPM, the committee recommends that a procedure log be maintained with documentation of procedure success and complications, including intravascular injection, nerve injury, infection, and pneumothorax.

Also, the Joint Committee recommends that individuals who engage in USPM continue to participate in continuing education even after the completion of the initial learning process. In addition, following initial exposure to USPM, continual use of ultrasound skills is recommended to maintain proficiency and personal comfort level with performing USPM.

Fellowship-Based Pathway Recommendation

A fellowship-based pathway should be the primary mode for pain medicine fellows to attain competency in USPM during matriculation in Accreditation Council for Graduate Medical Education–accredited or equivalent programs. The training program should incorporate the 6 core competencies as defined by the Accreditation Council for Graduate Medical Education (Appendix 4). If available, the USPM coordinator is the individual responsible for coordinating and organizing education to attain the recommended USPM core competencies.

The didactic component should consist of the fellow completing a defined USPM curriculum that addresses the 4 major categories described under the proficiency section. Pain medicine fellowship program directors should have flexibility to present the curriculum during the fellowship period. In addition, ultrasound training may further occur through coordination with the UGRA service. The recommended curriculum is provided in Appendix 5.

The Joint Committee recommends that each fellow perform enough ultrasound-guided blocks to satisfy the aforementioned core competencies and skill sets. The Joint Committee also recommends that each fellow have exposure to varying types of pain procedures, including axial, peripheral, and MSK applications. Each fellow should keep a database log of his/her procedures. Fellows are encouraged to record and store static images and video clips of the critical aspects of each procedure. The fellow should periodically review static images and video with appropriate supervision to confirm proper scanning and needle insertion techniques.

QUALITY IMPROVEMENT

For both the practice pathway and fellowship-based pathways, it is recommended that a continuous quality improvement (CQI) program be present during the initial training and that it continue after the completion of each pathway. The goal of the CQI program is to promote the safe and appropriate use of USPM. The CQI program should continue to evaluate the multiple technical and knowledge parameters suggested in the pathway recommendations, including knowledge of relevant anatomy, ultrasound equipment, and procedural technique. In addition, the process implemented should be able to identify the maintenance of procedural technical competency and appropriate image interpretation. The evaluation should also include periodic competency assessment that monitors the performance of procedures in a safe and efficient manner. The process should provide constructive and timely feedback to both practicing physicians and trainees. Complication rates should continue to be tracked and monitored. Processes for the quality assurance in the USPM program may include reviews of still images and videos from a procedural database and/or direct supervision of procedures. Specific individuals or, if available, the USPM coordinator at each institution may be appointed to oversee the quality assurance/improvement program.

Ultrasound equipment should be periodically inspected per the manufacturer's recommendations by each institution's biomedical engineering department to ensure that the machines are in appropriate working condition. Institutional and national standards need to be followed for the cleaning and disinfection of the ultrasound equipment (Appendix 1).

Credentialing and Privileging

Specific recommendations have not been provided for the credentialing or privileging of individual practitioners to perform USPM. The process of credentialing and authorizing clinical privileges will depend on the individual institution, department policies, and geographic location (eg, international setting). To promote the safe and effective practice of USPM, the training requirements provided in this document should serve as a foundation for the appropriate education of physicians performing USPM. The Joint Committee recommends that the preceding training guidelines for the practice-based and the fellowship-based pathways serve as an educational framework for high-quality training.

Ultrasound Research for Interventional Pain Procedures

Currently, a majority of the research on ultrasound for interventional pain medicine consists of a small case series, observational, feasibility, and technical studies.[2,3] Randomized controlled trials do exist for lumbar facet intra-articular injections and some MSK applications.[2,19] Future larger-scale studies are needed on the safety and efficacy of ultrasound-guided techniques in chronic pain management, with direct and correct comparison to landmark-based and fluoroscopy-guided techniques. Attention should also be directed in study design to humanistic (eg, associated procedural pain) and economic outcomes.

Limitations and Challenges of Ultrasound for USPM

Ultrasound imaging has several limitations. It is recommended that the education and training process cover current limitations for USPM and continue to update these described limitations as the techniques evolve and new scientific literature is published. The ultrasound-guided pain medicine techniques and associated images are operator, anatomic location, and patient dependent. Patient characteristics, such as prior surgical intervention, obesity, and degenerative changes, may negatively limit the quality of the ultrasound image. Furthermore, the quality of the image in certain areas is poor. This is particularly true in the visualization of axial or spine structures where an acoustic shadow artifact is produced by bone, which has a high attenuation coefficient. Another limitation is the visualization of a thin needle or a needle inserted at a steep angle.

The inability to detect epidural intravascular injection and the spread of the injectate also significantly limits the use of ultrasound for selected neuraxial procedures in chronic pain.[2,20]

CONCLUSIONS

Ultrasound guidance for chronic pain procedures is rapidly evolving. The goal of the Joint Committee's recommendations is to promote the safe and the efficacious utilization of ultrasound for pain medicine procedures. The Joint Committee's recommendations and training guidelines provide a structure for attaining and maintaining proper levels of competency, proficiency, and quality improvement for USPM. The use of ultrasound for the performance of peripheral nerve blocks, axial blocks, and MSK is within the scope of practice of an appropriately trained pain physician.

ACKNOWLEDGMENTS

The authors thank the members of the Special Interest Group for Ultrasonography in Pain Medicine for all their input and feedback.

REFERENCES

1. Narouze S, Peng PW. Ultrasound-guided interventional procedures in pain medicine: a review of anatomy, sonoanatomy, and procedures. Part II: axial structures. *Reg Anesth Pain Med*. 2010;35:386–396.
2. Narouze SN. Ultrasound-guided interventional procedures in pain management: evidence-based medicine. *Reg Anesth Pain Med*. 2010;35:S55–S58.
3. Neal JM, Brull R, Chan VW, et al. The ASRA evidence-based medicine assessment of ultrasound-guided regional anesthesia and pain medicine: executive summary. *Reg Anesth Pain Med*. 2010;35:S1–S9.
4. Peng PW, Narouze S. Ultrasound-guided interventional procedures in pain medicine: a review of anatomy, sonoanatomy, and procedures: part I: nonaxial structures. *Reg Anesth Pain Med*. 2009;34:458–474.
5. Gofeld M. Ultrasonography in pain medicine: a critical review. *Pain Pract*. 2008;8:226–240.
6. American Medical Association House of Delegates. Privileging for ultrasound imaging. Resolution 802, December 1999; reaffirmed; Sub. Res 108, June 2000. H-230.960. Available at: http://www.ama.assn.org. Accessed December 2, 2012.
7. American College of Emergency Physicians. American College of Emergency Physicians. ACEP emergency ultrasound guidelines-2001. *Ann Emerg Med*. 2001;38:470–481.
8. American College of Emergency Physicians. Emergency ultrasound guidelines. *Ann Emerg Med*. 2009;53:550–570.
9. Shanewise JS, Cheung AT, Aronson S, et al. ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transesophageal echocardiography examination: recommendations of the American Society of Echocardiography Council for Intraoperative Echocardiography and the Society of Cardiovascular Anesthesiologists Task Force for Certification in Perioperative Transesophageal Echocardiography. *Anesth Analg*. 1999;89:870–884.
10. Sites BD, Chan VW, Neal JM, et al. American Society of Regional Anesthesia and Pain Medicine, European Society of Regional

Anaesthesia and Pain Therapy Joint Committee: the American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia and Pain Therapy Joint Committee recommendations for education and training in ultrasound-guided regional anesthesia. *Reg Anesth Pain Med*. 2010;35:S74–S80.

11. Finnoff J, Lavallee ME, Smith J. Musculoskeletal ultrasound education for sports medicine fellows: a suggested/potential curriculum by the American Medical Society for Sports Medicine. *Br J Sports Med*. 2010;44:1144–1148.
12. Pineda C, Reginato AM, Flores V, et al. Pan-American League of Associations for Rheumatology (PANLAR) recommendations and guidelines for musculoskeletal ultrasound training in the Americas for rheumatologists. *J Clin Rheumatol*. 2010;16:113–118.
13. Sites BD, Macfarlane AJ, Sites VR, et al. Clinical sonopathology for the regional anesthesiologist: part 1: vascular and neural. *Reg Anesth Pain Med*. 2010;35:272–280.
14. Sites BD, Macfarlane AJ, Sites VR, et al. Clinical sonopathology for the regional anesthesiologist: part 2: bone, viscera, subcutaneous tissue, and foreign bodies. *Reg Anesth Pain Med*. 2010;35:281–289.
15. US Food and Drug Administration. Department of Health and Human Services. FDA Radiological Health Program. Available at: http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/ucm115357.htm#rb. Accessed December 2, 2011.
16. Shankar H, Pagel PS. Potential adverse ultrasound-related biological effects: a critical review. *Anesthesiology*. 2011;115:1109–1124.
17. Pekkafahli MZ, Kiralp MZ, Basekim CC, et al. Sacroiliac joint injections performed with sonographic guidance. J *Ultrasound Med*. 2003;22:553–559.
18. Niazi AU, Haldipur N, Prasad AG, Chan VW. Ultrasound-guided regional anesthesia performance in the early learning period: effect of simulation training. *Reg Anesth Pain Med*. 2012;37:51–54.
19. Sibbitt WL Jr, Peisajovich A, Michael AA, et al. Does sonographic needle guidance affect the clinical outcome of intraarticular injections? *J Rheumatol*. 2009;36:1892–1902.
20. Narouze SN, Vydyanathan A, Kapural L, Sessler DI, Mekhail N. Ultrasound-guided cervical selective nerve root block: a fluoroscopy-controlled feasibility study. *Reg Anesth Pain Med*. 2009;34:343–348.
21. Muradali D, Gold WL, Phillips A, Wilson S. Can ultrasound probes and coupling gel be a source of nosocomial infection in patients undergoing sonography? An in vivo and in vitro study. *AJR Am J Roentgenol*. 1995;164:1521–1524.
22. Hutchinson J, Runge W, Mulvey M, et al. *Burkholderia cepacia* infections associated with intrinsically contaminated ultrasound gel: the role of microbial degradation of parabens. *Infect Control Hosp Epidemiol*. 2004;25:291–296.
23. Rutala WA, Weber DJ, and Healthcare Infection Control Practices Advisory Committee (HICPA). Centers For Disease Control and Prevention Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. Available at: http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf. Accessed December 2, 2011.
24. Centers for Devices and Radiological Health: Centers for Devices and Radiological Health Guidance for Industry and FDA Staff: Information for Manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers, September 9, 2008. Available at: www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/UCM070911.pdfcdc. Accessed December 2, 2011.
25. Abdullah BJ, Mohd Yusof MY, Khoo BH. Physical methods of reducing the transmission of nosocomial infections via ultrasound and probe. *Clin Radiol*. 1998;53:212–214.

APPENDIX 1:

Aseptic Technique for Ultrasound-Guided Interventional Pain Procedures

When performing ultrasound-guided interventional pain procedures, aseptic technique should be followed. Both ultrasound coupling gel and transducers can be sources of nosocomial infection.[21,22] Below are the listed steps for maintaining ultrasound transducer sterility.

1. Prior to performing ultrasound scanning, confirm that the ultrasound equipment was cleaned and disinfected according to the specific institutional policy. The level of disinfection required depends on the procedure being performed and the tissue that will be contacted by the transducer.
2. The US Food and Drug Administration and the Centers for Disease Control and Prevention provide further guidance on transducer sterility and chemical sterilants/high-level disinfectants.[23,24]
3. A sterile ultrasound sheath or sterile adhesive transparent dressing should be utilized.[25] The anatomic location and the need to cover the transducer cord will dictate which type of dressing is appropriate. For example, for single-injection techniques involving peripheral structures, an adhesive sterile transparent dressing may be used in place of the sterile sheath. Make sure that all portions of the cord that will come in contact with the procedural field are contained within a sterile sheath.
4. An ultrasound coupling agent should be placed between the transducer and the inside of the sterile sheath, ensuring that there is good contact and no air bubbles. For the adhesive dressing, it is not necessary to place gel between the transducer surface and the dressing.
5. Sterile ultrasound coupling agent is applied between the skin and the covered transducer.
6. At the end of the procedure, the sterile cover is properly disposed.
7. The transducer is then cleaned and disinfected according to hospital policy.

APPENDIX 2:

Documentation

The following steps are recommended for appropriate documentation.

1. Create a separate procedure note that is stored in the medical record. The written report should identify the individual who performed the procedure, reason for the procedure, description of relevant procedural anatomy and pathology, and explanation of the procedure.
2. Image documentation and storage should occur through a hard copy or electronic archival system. Minimum image documentation recommendations include visualization and labeling of appropriate anatomic structures, including the target structure, needle localization, and injectate spread (when applicable). Recorded videos should be encouraged when feasible.

For further information on documentation requirements for appropriate reimbursement, refer to specific policies dictated by regulatory and payer entities.

APPENDIX 3:

Ultrasound-Guided Pain Medicine Coordinator

A staff physician in each Department of Pain Medicine may be identified by the departmental leadership to assist in the safe and skilled implementation of USPM. The USPM coordinator will support the education and supervision of pain physicians performing USPM. In a training institution, the coordinator, if available, will also be responsible for developing and coordinating the fellow educational instruction needed to achieve the core competencies required for USPM.

The Joint Committee recommends that physician candidates for the position of USPM coordinator obtain the following:

1. a letter of recommendation from department leadership;
2. a written description of clinical experience, including case volume, length of experience, and safety; and
3. participation in at least 1 accredited ultrasound workshop (as described in the training section).

APPENDIX 4:

Core Competencies for Fellowship Training in USPM

The following list overlaps with the skills defined in the proficiency section of the practice pathway:

Patient Care

1. Perform gentle ultrasound examinations, providing appropriate sedation if indicated.
2. Demonstrate proper patient selection.
3. Use appropriate monitoring during USPM.
4. Demonstrate proper target localization techniques.
5. Perform effective and safe procedures.

Ultrasound Knowledge

1. Understand the general principles of ultrasound physics.
2. Understand benefits and limitations of USPM techniques.
3. Understand differences between in-plane versus out-of-plane techniques and their respective advantages and disadvantages.
4. Understand key artifacts and pitfall errors associated with USPM.
5. Develop knowledge of sonoanatomy of the spine, paraspinal structures, peripheral nerves, muscles, tendons, and joints.
6. Appreciate common nonneural pathological states that are diagnosed by ultrasound.
7. Establish familiarity with the major scientific literature related to USPM.
8. Learn techniques for USPM (refer to list of applications in Table 1).
9. Understand the applications and interpretation of color and power Doppler.
10. Understand equipment specifications.
11. Comply with procedures for infection control and equipment cleaning.

Interpersonal/Communication Skills

1. Communicate sensitively and effectively with patients and their families regarding ultrasound findings.
2. Explain any complexities of USPM in terms that the patient can understand.
3. Demonstrate team leadership/management skills for the management of an effective pain medicine service.

Professionalism

Be open to constructive criticism regarding ultrasound skills.

System-Based Practice

1. Recognize costs associated with various imaging modalities, for example, fluoroscopy, ultrasound, computed tomography scan, and magnetic resonance imaging.
2. Collaborate with other members of the health care team to ensure quality patient care.
3. Use evidence-based, cost-effective strategies in caring for all patients.

Practice-Based Learning and Improvement

1. Identify and acknowledge gaps in personal knowledge and skills in the care of patients presenting for USPM.
2. Use textbook and online and computer-based resources to broaden knowledge base regarding USPM techniques.
3. Perform electronic searches of the medical literature to identify articles that address the medical issues surrounding USPM.
4. Understand and critically evaluate USPM outcome studies.
5. Attend the department's required teaching conferences.
6. Develop time management skills to perform the required tasks in a reasonable amount of time with satisfactory quality.

APPENDIX 5:

Recommended Ultrasound Curriculum

Equipment Specifications

Minimum ultrasound machine specifications include a machine with a linear transducer with high frequency, curved transducer with low frequency, color Doppler technology, and image storage/transfer capabilities.

Curriculum Content: Scanning Techniques

- The role of ultrasound physics pertinent to USPM; understand terminology (eg, piezoelectric effect, frequency, resolution, attenuation, echogenicity, color Doppler, power Doppler).
- The role of instrumentation in image acquisition (eg, image mode, gain, time gain compensation, transducer types).
- Equipment requirements: types of transducers (linear, curved and phased array for different indications and scanning at different depths), footprint length, and frequency (range, 2–18 MHz).
- Ultrasound acoustic artifacts and imaging artifacts (pitfalls); these include reverberation artifacts, acoustic enhancement, acoustic shadowing, gain-related artifacts, resolution-related artifacts, mistaking tendon or muscle for nerve, and anisotropic behavior of tissues (especially nerves and tendons).
- Techniques to perform effective ultrasound examinations; appreciate the Joint Committee–recommended PART maneuvers for generating optimal imaging: pressure, alignment, rotation, and tilt.

■ The role of maintaining appropriate ultrasound ergonomics to improve technical proficiency and reduce work-related MSK strain disorders.

Curriculum Content: USPM Procedures

1. Define patient selection, indications, and contraindications.
2. Practice procedural technique on available organic and inorganic simulators.
3. Define relevant anatomy in each region, including the ability to identify muscle, tendon, bone, nerve, vessels, and pleura.
4. Define needle insertion technique (in-plane vs out-of-plane).
5. Understand potential difficulties and pitfalls.
6. Describe ultrasound appearance of common anatomic variations seen during MSK, axial, and nonaxial pain procedures.
7. Recognize correct and incorrect injectate spread.