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Review Article

Advancing Simulation-Based Education in Pain Medicine

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Abstract

Background. The Accreditation Council for Graduate Medical Education (ACGME) has recently implemented milestones and competencies as a framework for training fellows in Pain Medicine, but individual programs are left to create educational platforms and assessment tools that meet ACGME standards.

Objectives. In this article, we discuss the concept of milestone-based competencies and the inherent challenges for implementation in pain medicine. We consider simulation-based education (SBE) as a potential tool for the field to meet ACGME goals through advancing novel learning opportunities, engaging in clinically relevant scenarios, and mastering technical and nontechnical skills.

Results. The sparse literature on SBE in pain medicine is highlighted, and we describe our pilot experience, which exemplifies a nascent effort that encountered early difficulties in implementing and refining an SBE program.

Conclusions. The many complexities in offering a sophisticated simulated pain curriculum that is valid, reliable, feasible, and acceptable to learners and teachers may only be overcome with coordinated and collaborative efforts among pain medicine training programs and governing institutions.

Key Words. Pain Training Programs; ACGME; Simulation

Introduction

Competencies and milestones are now an expected part of postresidency pain specialty training.

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The Accreditation Council for Graduate Medical Education (ACGME) published core competencies in Pain Medicine for implementation by July 2015. These requirements for competency-based education (CBE) require new strategies for implementing milestones into pain medicine curricula. Compared with traditional didactic or apprenticeship models of learning and teaching, simulated educational experiences offer several advantages for CBE and evaluation. The use of simulation has been shown, in Anesthesiology and other fields, to facilitate education of technical and nontechnical skills among providers [1]. Simulation is well suited for competency-based education, but novel and sophisticated platforms may be difficult for individual pain programs to develop, test, and implement.

This article explores the potential for simulation-based education (SBE) in the field of pain medicine as a modality for helping programs and trainees meet the growing demand for CBE. We discuss the evolution of CBE in pain medicine, while highlighting the difficulties in implementing curricula, that clearly identifies progression of ACGME milestones for individual learners. We describe the educational needs of trainees in pain medicine that may be met with SBE and review the sparse literature that is specific to pain fellowship training programs. A high-fidelity simulation program for pain fellows developed at our institution is presented as an example of case creation, curriculum implementation, reliability testing of assessment tools, and quality assurance using videotaping. Through this experience in developing a competency-based simulation curriculum, we discovered challenges and opportunities in meeting the ACGME requirements for pain medicine. Lastly, we offer pathways for demonstrating competency and patient safety as well as a vision for collaborative efforts in our field to develop, validate, and test a feasible simulation curriculum.

Background: The Evolution of Milestones

In 1999, the ACGME introduced six overarching core competencies: patient care, medical knowledge, professionalism, interpersonal communication, system-based practice, and practice-based learning and improvement. Ten years later, the ACGME began transitioning the original core competencies into an outcome-based assessment where measurable and observable developmental steps known as educational milestones are assigned to competencies [2]. Milestones for Anesthesiology became available in July 2013 while those for Pain Medicine were published in 2014 and revised in subsequent years [3]. Milestones rely on the six core competencies as the platform and provide a framework for the trainee and the training program to assess and document the trainee's trajectory from novice to proficient practitioner in unsupervised practice. There are 24 subcompetencies within pain medicine among the six core competencies: patient care (6), medical knowledge (3), systems-based practice (4), practice-based learning (4), professionalism (4), and interpersonal and communication skills (3) (see Table A1 for a list of the ACGME pain core competencies and subcompetencies).

Informed by expert input within each specialty and subspecialty, each program is individually responsible for the integration of milestones into curriculum, the mapping of trainee activities to each competency, and the documentation of progression within milestones. During semi-annual review, programs are required to summarize each fellow's performance and report the milestone level achieved to the ACGME. For example, the progression through a competency may follow as such:

Level 1: The fellow demonstrates milestones expected of an incoming fellow.

Level 2: The fellow is advancing and demonstrates additional milestones, but is not yet performing at a midfellowship level.

Level 3: The fellow continues to advance and demonstrate additional milestones, consistently including the majority of milestones targeted for fellowship.

Level 4: The fellow has advanced so that he or she now substantially demonstrates the milestones targeted for fellowship. This level is designed as the graduation target.

Level 5: The fellow has advanced beyond the performance targets set for the fellowship and is demonstrating "aspirational" goals that might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional fellows will reach this level [3].

An example of a patient care competency, possibly amenable to SBE, with progressive milestone ratings is provided in Table A2.

The field of Anesthesiology has the same ACGME core competencies but with differing subcompetencies and milestones than pain medicine but is perhaps years ahead in developing assessment tools for trainees. Anesthesiology residency programs have partly addressed the need in their specialty by congregating resources and testing validation tools under the leadership of organizations such as the Society for Education in Anesthesia (SEA; http://www.seahq.net) and the American Society of Anesthesiology (ASA) [4].

The Conundrum of Enacting Milestones and Where Simulation May Fit

Milestones can be met using a variety of time-tested assessment methods. Certain methods for evaluation may be better suited for a particular competency than others. For example, in-training examinations or internal examinations may be more effective for assessing medical knowledge than qualities such as communication or professionalism. These latter competencies might be better evaluated using objective structured clinical examinations (OSCEs), peer review, patient feedback, case-based study, or standardized patients [5]. Other common evaluation strategies include direct or indirect supervision by faculty (the apprenticeship model), oral presentations, chart reviews, portfolios, and checklists. Faculty supervision is the most commonly used measurement for many of the core competencies but can be limited by frequency of observation or bias.

Clinical skills in pain medicine involving difficult patient interactions and management of procedural complications are vital for trainees to learn but may not be common enough to be adequately supervised by faculty. For example, emergencies in interventional pain management, such as the recognition and treatment of local anesthetic toxicity, may be so infrequent that trainees will likely graduate without ever receiving the experience necessary to achieve competence. In areas where clinical competency is required despite limited direct clinical experience, inadequate patient exposure can be compensated by an SBE platform. Additionally, multiple competencies, including communication, professionalism, and patient care, can be assessed simultaneously through an immersive and sophisticated simulated case.

Anesthesiology and other fields have long embraced simulation as a tool for evaluation and training, yet this modality has not been routinely incorporated in Pain Medicine. Simulation in anesthesiology has included topics such as airway management, ultrasound/regional anesthesia, obstetric anesthesia, and cardiothoracic anesthesia, as well as assessments of nontechnical skills. Evidence suggests that these experiences result in high levels of satisfaction among participants and may improve patient outcomes [6]. Credentialing and certifying bodies have embraced high stakes simulation in their licensing of practitioners and for maintenance of certification [7,8]. The ACGME and other governing organizations have supported simulation as a tool for both formative and summative assessments [9]. Swing et al. [10] assessed the variety of teaching modalities recognized by ACGME and found that simulation-based cases were evidence-based in meeting criteria for core competencies. The ACGME advises that there are no "valid and reliable" tools for workplace assessment; rather, graders should focus on understanding available tools and develop expertise in the assessment process, taking into account variability [2,11]. Methods to reduce variability may include calculating internal consistency and inter-rater reliability for each rater and metric. These additional steps may be daunting but are necessary for summative evaluations.

Applying Competencies and Milestones in Pain Medicine

Pain medicine involves the diagnosis, treatment, and management of a wide assortment of conditions, requiring practitioners to have broad-based knowledge that includes a detailed understanding of pharmacological, psychological, medical, and interventional approaches. Pain medicine trainees matriculate from diverse primary residency training programs (such as anesthesiology, neurology, physical medicine and rehabilitation [PM&R], or psychiatry), each with a different background in patient care. Some may be well versed in physical examination, while others may be more proficient in procedural skills. Nonanesthesiologists have an additional set of anesthesiology-based requirements during the fellowship: sedation administration, mask ventilation, and intubation. As no single primary specialty offers all the expertise for success in an ACGME-accredited pain medicine fellowship, some of these essential skills must be supplemented to ensure competent, safe, and independent practice. Although ACGME milestones offer some guidance in achieving competency, a standardized or systematic approach to achieving milestones in pain fellowship training is currently lacking.

Simulated Learning in Support of Competency and Milestones in Pain Medicine

SBE may be particularly well suited to the complexity and variety of skills required in pain medicine. It also has several advantages for CBE over traditional didactic or apprenticeship models. These include the ability to intentionally practice prior to treating live patients, refine cases based on trainee experiences, review performance during individual or group debriefing sessions, provide experiences in clinical quality improvement (such as mock codes), and offer remediation. Educators would be able to document achievements of demonstrable end points while offering direct hands-on experiences and deliberate practice using SBE. Learning through SBE exercises rooted in the pain medicine milestones offered to each trainee in a highly reproducible manner can offer clinically relevant experiences [12]. Simulation controls for the variable clinical experiences encountered by each trainee and ensures that high-yield clinical skills, no matter how rare, are learned and evaluated. Simulation may be particularly helpful for skills that are difficult to appraise such as time management, applying knowledge, processing information, reasoning, setting priorities, correct sequencing of actions, and awareness of limits [1]. Lastly, these experiences also have the ability to become more complex over time, in alignment with the ACGME's requirement that learners' transition from novice to expert with an emphasis on an individual learner's pace [12].

Scoring simulated exercises and developing rubrics of criteria for performance for technical and nontechnical skills have been described in multiple clinical fields [1,13,14]. Metrics have included a checklist of critical actions completed and leadership and communication scales such as the Oxford Non-Technical Skills Scale (NOTECHS) or the Anaesthetists' Non-Technical Skills (ANTS) [13,15,16]. Others have studied direct ways to link simulated experiences with ACGME core competencies. Rosen et al. [17] proposed a methodology for emergency medicine training that systematically links scenario development, measurement of performance, and feedback to predefined learning goals based in the ACGME core competencies. The eight-step process begins with identifying core competencies, learning objectives, specific events, skills, and attitudes that plausibly demonstrate competency. Events are predetermined and controlled within the scenario to encourage reliable and valid measurements. Initial evaluation of this methodology demonstrated that it was “easy” to use, was useful for assessment and feedback, and had high agreement between raters scoring the same scenario. This supports tailoring SBE to milestones (depending on the student’s stage of training) where observable and predetermined behaviors are linked to competencies.

Review of the Literature on Graduate-Level Pain Education and Simulation

Few reports demonstrate the use of simulation in pain medicine training curricula as an adjunct learning experience. A complete review of SBE is beyond the scope of this report [18–20]. A PubMed search revealed only two articles describing simulation for pain medicine fellow trainees. Brenner et al. [21] described an interprofessional simulation-based curriculum encompassing physicians, nurses, and physician fellows who trained with three crisis resource management (CRM) algorithms and practiced a bioethics case founded on responding to a medical error. Following the program, a survey of the participants found the interprofessional component of the training to be particularly well received, with high ratings of “excellent” among faculty and trainees. Hoelzer et al. [22] created a simulation curriculum, based on trainee input, highlighting difficult conversations and one CRM algorithm. The sessions were videotaped and used in the debriefing to consolidate learning and facilitate discussion. Participants reported increased comfort with challenging patient encounters after the training sessions. Additionally, both reports provided sample cases and instructor documents for use by others practicing interventional pain management [21,22].

Early Experience in Developing Competency-Based Education Using Simulation

Although Brenner et al. and Hoelzer et al. present useful simulated case curricula for trainees and programs, we found no reports in the medical literature of formative or summative assessments of skill and knowledge acquisition in pain education. Our faculty addressed this gap through using simulated cases developed over several years that were tested among a single fellowship class (2012–2013, N = 5) to assess American Board of Anesthesiology (ABA) and ACGME achievement-oriented competencies and educational milestones. Pain Medicine faculty members at the University of California, Davis, developed cases by identifying topics associated with desired proficiencies and relevant pain core competencies. The coordinating faculty member for this project was trained through several hours of mentorship with an in-house simulation expert and one year of development and testing of simulation scenarios among a previous fellowship class. Two additional faculty members attended a one-hour training session focusing on rating the scenarios under the direction of the coordinating faculty member. Through a institutional review board (IRB) approved pilot study, pain management trainees performed five high-fidelity mannequin-based scenarios in an outpatient setting based on complications from common interventional pain procedures. These included: 1) iatrogenic pneumothorax, 2) local anesthetic (LA) toxicity, 3) seizure management, 4) pacemaker dysfunction, and 5) ventricular fibrillation (VF) (see Table A3 for an example of a current scenario and checklist being utilized at our institution). This SBE program consisted of a written knowledge test (pre- and post-test), realistic production of relevant emergency events, a critical action scoring system (checklist) for assessing and standardizing the performance of each trainee, and a postexperience satisfaction survey. The identical CRM cases were repeated six months later with an opportunity for self-study in between the simulated exercise time points.

Trainee performance was evaluated and scored independently by three faculty members, one in real time (the coordinating faculty member) and two by delayed video, using a critical action checklist at baseline and six months later. Statistical analyses were performed with SAS version 9.2 (SAS Institute Inc., Cary, NC, USA). The group-mean scores for the five scenarios at baseline and at the six-month retest showed improvement in four out of five case scenarios. The intraclass correlation coefficient (ICC), where an ICC of <0.2 was considered poor, 0.21–0.4 was fair, 0.41–0.6 was moderate, and 0.61–0.8 was good, was used to assess inter-rater reliability. A Bland-Altman plot of the average and difference of real-time and videotaped scores at baseline and six-month retest were used to assess the level of agreement between the real-time and videotaped evaluations where a range of agreement was defined as mean bias $\pm 2\times$ the standard deviation of the difference. Correlation and agreement between real-time and video reviewers showed only good or moderate agreement in half of the cases and time points. A test of knowledge (pre- and post- experience) did not significantly change from uniformly high pre- and post-test scores. The brief satisfaction survey showed that 100% of the participants felt that the cases were relevant to practice and that objectives were met.

Although our experience demonstrated the feasibility of a simulated curriculum and highlights the need for consistent and accurate assessment tools along with rater training, significant challenges and limitations were encountered. Analysis of faculty inter-rater reliability and agreement with our critical action checklist scoring system showed inconsistent rating of trainees among the faculty. Other educators have found similar variability when having faculty members score resident performances of simulated case scenarios [23–25]. The use of multiple raters and case scenarios along with offering many time points for assessment may partly mitigate this issue [26]. Larger numbers of scorers may improve quality assurance, guaranteeing learners of a fair process. As with any evaluation tool, inter-rater reliability and bias are important variables when assessing the performance of trainees [23,27].

Our experience highlighted the difficulty in recruiting faculty who could be available for real-time observation rather than for delayed video scoring. Video scoring offered the reviewers the benefit of rewinding the video and less disruption of clinical work. A real-time scorer was present during the entire simulation and was able to facilitate the case and potentially see or hear details that the may be missed on a videotape. However, the real-time scorer is limited in time to score and cannot replay the simulation.

Our early version of this curriculum appears to have been valuable for this initial class and has been refined and re-implemented with subsequent fellowship classes. The validity and reliability of our pilot program is complicated by the low number of participants and the progressive revisions of the cases based on trainee feedback with each fellowship class, leading to different cases for each subsequent class. Our initial program also revealed the need to prioritize faculty time and training in CBE and SBE, to reduce rater bias, and provide reproducible results between trainees and cases.

General limitations associated with SBE include the cost and resource-intensive nature of high-fidelity simulation, which may limit this modality for some academic and community-based fellowship programs. Aside from the challenges and expense of implementing a simulated learning experience, creating an assessment process that is valid, generalizable, and reliable may be challenging due to the small number of participants at each individual academic pain medicine fellowship program.

A Path Forward

Recent implementation of milestones and competencies into medical education may have caught educators unprepared to meet the new requirements [28–32]. The demand to attain diverse, multifaceted, and individualized educational experiences may not be achievable in traditional didactic or apprenticeship models. ACGME-accredited pain medicine fellowship programs are expected to document progress from novice to expert with activities that increase in complexity and offer opportunities for remediation. Supplementation of traditional education with SBE, an evidence-based tool recognized by the ACGME, may be a sensible approach for addressing these requirements. The variety of low- and high-fidelity options for SBE are emerging as substantial learning and assessment tools that may address all six of the core competencies. The use of standardized patients, task trainers or "block" phantoms, computer modeling, and high-fidelity mannequin-based simulation offers a variety of options to educators, depending on need and available resources. This approach can develop and assess individual and team competence. Few other educational tools can so readily engage interprofessional teams in complex scenarios. Some have debated that the need for simulation in medical education is an ethical imperative, reducing dependence on "practicing on patients" [33].

We have described our experiences here in hopes of exemplifying a nascent effect that encountered early difficulties in implementing and refining an SBE program. We suspect that creating and implementing a sophisticated SBE platform may be daunting for individual programs with limited research and development resources. Thus, creating and testing training materials may require multi-institutional efforts or commercial ventures. Although no one training program is the same, the 100 ACGME-accredited pain medicine fellowship programs are unified by the ACGME milestones and core competencies.

Typically, SBE curricula are created by in-house experts, but collaboration with others at similar programs could expand knowledge and lead to possible consensus for model CBE/SBE programming as well as for a set of competencies that trainees should demonstrate before completing the fellowship. In order to develop and execute high-quality simulations, faculty should be skilled in the delivery of SBE. Although there are formal one- to two-year Simulation Fellowship Programs, it may be challenging to recruit faculty who are fellowship trained or unrealistic to send faculty to a fellowship program. Instead, departments can identify members for a core simulation faculty, based upon prior experience and interest in SBE. Immersive Simulation Instructor Courses from Simulation-Based Learning Centers are readily available throughout the country (e.g., Stanford Center for Immersive and Simulation-Based Training, https://cisl.stanford.edu/attend-a-course/simluation-instructor-course.html, and Harvard Center for Medical Simulation, https://harvardmedsim.org/training/simulation-instructor-training/). These three- to five-day courses expertly train faculty in adult learning theories, simulation techniques, development and design of simulation curriculum modules, and debriefing skills and techniques. Faculty may also learn SBE in a less formal mentorship setting through their institutional health care center for virtual care. Lastly, many online courses are available regarding debriefing strategies and simulation education in order to bolster faculty training.

It stands to reason that a consortium of training programs could assure production of enough consistent cases to effectively test a unified, reliable, validated, reproducible, feasible, and acceptable SBE platform for demonstrating core competencies. This could involve a consortia of training programs working collectively, perhaps even under the umbrella of professional societies and organizations. Shared materials, including metrics for assessment and faculty tools, would lower barriers for additional training programs to implement and possibly advance SBE. A local, regional, or national peer review process can be facilitated to review curricula, ensure that ACGME milestones are being addressed, discuss predetermined events and expected actions within the simulation, create assessment protocols, assign cutoffs for milestone-based Level 1–5 ratings, and review the execution and rater reliability of the simulation. In addition, participant and faculty peer-to-peer evaluations may be helpful in refining SBE platforms for future trainees.

Anesthesiology, surgery, internal medicine, and other fields have led endeavors to collect shared experiences, test curricula, and invest in faculty development by relying on the combined efforts of institutions and organizations [23,34]. Beeson and Vozenilek proposed the development of a curriculum for procedural competencies as a shared opportunity for programs to ensure uniform training [12]. Schwid et al. created a program in which anesthesia residents underwent the same simulated exercises at 10 different institutions and were scored by two on-site raters and one external rater. These authors reported reduced bias, increased validity, and interrater reliability and identified critical errors made by senior residents [26]. Although such sophisticated and coordinated efforts may be a difficult starting point for most pain medicine education programs, another option may be web- and computer-based virtual activities (e.g., the American Heart Association's HeartCode Advanced Cardiac Life Support program, cpr.heart.org) [35]. A web-based platform offers greater accessibility for training programs and trainees, but would likely require initial costs for development and production as well as maintenance costs.

Quality patient care and safety goals are not unique to pain medicine; neither is the need for training clinicians in managing complications without putting patients at increased risk. Other clinicians outside of pain medicine are increasingly performing interventional procedures or using sedation, exposing patients to potential harm. These clinicians include internists, pediatricians, neurologists, radiologists, surgeons, and other specialists who rely on close proximity to emergency services and technology within the hospital setting to ensure safety in the event of severe procedural complications. Adverse outcomes could increase as treatments progressively move to more cost-effective outpatient sites [36,37]. Any clinician performing interventional procedures with or without sedation in an outpatient setting has the potential to encounter emergency situations and may be the sole clinician responsible for managing a life-threatening complication. SBE offers the opportunity for all interventionalists, regardless of primary specialty or subspecialty, to practice and learn skills in performing essential life-saving actions [38]. SBE also supports the opportunity for pain medicine to lead the way in raising the standards for safe procedural practice across the health care spectrum.

Summary and Conclusions

Simulation strategies have been effectively employed to assess competencies in critical management and safety in other medical and nonmedical fields [1,7,17,18,39,40]. Evidence suggests that simulator performance of trainees correlates with other clinical and knowledge-based markers of competence [41,42]. Most importantly, SBE aims to improve patient-centered care and safety through the practice of clinically relevant cases [6,18–20,39,43–47]. In pain medicine, the ultimate goal of patient safety must remain paramount as new educational platforms are developed. Although SBE is well developed in high-acuity fields such as anesthesiology, emergency medicine, and surgery, pain medicine is also well suited to—and in need of—this approach.

Meeting the growing demand for competency-based health care education presents a challenging opportunity with great potential for improving the educational outcomes for our trainees [48–51]. Although designing and implementing de novo SBE programs can be resource-intensive, embracing this type of education offers potential advantages for training programs in need of demonstrating a required achievement of critically important milestones. As all ACGME-certified pain fellowship programs are now required to meet a high bar for demonstrating CBE with associated milestones, it seems unlikely that individual programs will be able to amass the resources necessary for realizing the full potential of SBE. This may represent a unique opportunity for individual pain medicine fellowship programs, and the organizations that unify them (i.e., ACGME, pain fellowship director organizations, and/or professional organizations), to form a consortium to develop and test uniform SBE programs that can be widely implemented.

Authors' Contributions

Dr. Singh participated in the study design, conduct of the study, data collection, data analysis, manuscript writing, and final manuscript preparation. Dr. Singh is the archival author of this study. Dr. Naileshni Singh attests to the integrity of the original study data and has approved the analysis reported in the final manuscript. Dr. Alison Nielsen participated in data collection, data analysis, manuscript writing, and final manuscript preparation. Dr. Alison Nielsen attests to the integrity of the original study data and has approved the analysis reported in the final manuscript. Dr. David Copenhaver participated in the study design, data collection, manuscript editing, and final manuscript preparation. Dr.David Copenhaver has approved the final manuscript. Dr. Samir Sheth participated in the study design, data collection, manuscript editing, and final manuscript preparation. Dr. Samir Sheth has approved the final manuscript. Dr. Chin-Shang Li contributed significant statistical data analysis for the study. Dr. Chin-Shang Li has approved the analysis and the final manuscript. Dr. Scott Fishman participated in the conceptual study design, editing of the manuscript, and final manuscript preparation. Dr. Scott Fishman has approved the final manuscript.

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APPENDIX

Table A1 The six core ACGME competency-based developmental outcomes: pain medicine milestones

Patient Care
Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s): 1. performs a directed neurological history and performs detailed neurological examination.
Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s): 2. performs a comprehensive musculoskeletal and appropriate neuromuscular history and examination.
Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s): 3. performs a complete psychiatric history and mental status examination with special attention to psychiatric and pain comorbidities.
In collaboration with the patient, develops and achieves a comprehensive pain treatment plan for each patient; includes consideration of available pharmacologic, behavioral, rehabilitative, interventional, and complementary/alternative approaches.
Demonstrates skills in performing and interpreting diagnostic and therapeutic interventions: appropriate use and interpretation of diagnostic laboratory and imaging studies; appropriate use and interpretation of electro-diagnostic studies; performs intravenous access, basic and advanced airway management, management of sedation, and basic and advanced cardiac life support; performs a wide range of invasive pain treatments involving the neuraxis, peripheral nerve, and musculoskeletal system.
Requests and provides consultative care.
Medical Knowledge
Possesses clinical knowledge: anatomy, physiology, and pharmacology of pain; assessment of pain; treatment of pain; interventional pain treatment.
Demonstrates knowledge of diagnostic laboratory, diagnostic imaging, and neuro-diagnostic testing and procedures.
Participates in scholarship (foundation, investigation, analysis, and dissemination).
Practice-Based Learning and Improvement
Monitors practice with a goal for improvement.
Learns and improves via performance audit.
Learns and improves via feedback.
Learns and improves at the point of care.
Professionalism
Has professional and respectful interactions with patients, caregivers, and members of the interprofessional team (e.g., peers, consultants, nursing, ancillary professionals, and support personnel).
Accepts responsibility and follows through on tasks.
Responds to each patient's unique characteristics and needs.
Exhibits integrity and ethical behavior in professional conduct.
Interpersonal and Communication Skills
Communicates effectively with patients and caregivers.
Communicates effectively in interprofessional teams (e.g., with peers, consultants, nursing, ancillary professionals, and other support personnel).
Appropriately utilizes and completes health records.

Source: [3].

Table A2 Pain medicine milestones, ACGME report worksheet example for one of the patient care competencies

Patient Care – Demonstrates Skills in Performing and Interpreting Diagnostic and Therapeutic Interventions

- Appropriate use and interpretation of diagnostic laboratory and imaging studies
- Appropriate use and interpretation of electro-diagnostic studies
- Performs intravenous access, basic and advanced airway management, management of sedation, and basic and advanced cardiac life support
- Performs a wide range of invasive pain treatments involving the neuraxis, peripheral nerve, and musculoskeletal system

Level 1	Level 2	Level 3	Level 4	Level 5
Observes but does not perform invasive procedures Inconsistently recognizes cases in which invasive procedures are unwarranted or unsafe Limited understanding of the indications, processes, or potential risks of the procedure Unable to describe the risks and benefits of procedures Limited ability to recognize patients who would benefit from diagnostic testing Limited ability to interpret diagnostic tests	Possesses insufficient technical skills for safe completion of common invasive procedures with appropriate supervision Inattentive to patient safety and comfort when performing invasive procedures Recognizes the ethical principles and need to obtain informed consent for procedures, but ineffectively obtains it Inconsistently recognizes patients who would benefit from diagnostic testing Inconsistently interprets diagnostic tests	Possesses basic technical skill for the completion and interpretation of some common invasive procedures with appropriate supervision Inconsistently manages patient safety and comfort when performing invasive procedures Inconsistently recognizes appropriate patients, indications, and associated risks in the performance of invasive procedures Obtains and documents informed consent Recognizes patients who would benefit from diagnostic testing Interprets diagnostic tests with limited ability to integrate results into treatment plan	Consistently demonstrates technical skill to successfully and safely perform and interpret invasive procedures Maximizes patient comfort and safety when performing invasive procedures Consistently recognizes appropriate patients, indications, and associated risks in the performance of invasive procedures Effectively obtains and documents informed consent in challenging circumstances (e.g., language or cultural barriers) Consistently integrates results of diagnostic testing into treatment plan	Demonstrates skill to independently perform and interpret complex invasive procedures that are anticipated for future practice Demonstrates expertise to teach and supervise others in the performance of invasive procedures Designs consent instrument for a human subject research study; files an Institutional Review Board application Appropriately orders and interprets complex diagnostic testing and integrates results into treatment plan Quantifies evidence for risk-benefit analysis while obtaining informed consent for complex procedures or therapies

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Comments: Not yet achieved Level 1 ☐

Source: [3].

Table A3 Local anesthetic toxicity case

Objectives:
1. Utilize resources in an emergency situation.

2. Identify a life-threatening process but also have a list of well-developed differential diagnoses.

3. Manage local anesthetic toxicity including airway, breathing, and circulatory support.

4. Manage LA toxicity with Intralipid.

Supplies: oral/nasal airway, nonrebreather mask, bag valve mask, Intralipid, endotracheal tube, laryngoscope, rescue medications, crash cart with defibrillator, CO2 absorber, gurney, stethoscope

Case Presentation	Goals	Actions
Eileen is a 41-year-old woman who presents for peripheral nerve block of the right-sided axillary nerve; she is given 10 mL of 0.75% bupivacaine for the block Setting: holding area, monitors on, supine on gurney NKDA Meds: fentanyl PMH: neuritis PSH: multiple right-handed surgeries Weight: 70 kg 22-gauge PIV in left hand Vital signs Preprocedure: BP 122/83, HR 72, oxygen saturation 100% on room air Intraprocedure: BP 120/70, HR 60, oxygen saturation 100% on room air	POSSESS CLINICAL KNOWLEDGE OF INTERVENTIONAL PAIN TREATMENT Utilize resources, alert staff, call for help Identify local anesthetic–induced toxicity Provide for a safe environment for patient and staff	**Assess patient** COMMUNICATES EFFECTIVELY W/ PATIENT ☐ adequate ☐ marginal ☐ none
Patient reports feeling lightheaded and dizzy, EKG shows asystole. Patient becomes unresponsive and apneic.Vital signs: no pulse, oxygen saturation of 90%	Direct resources in a critical situation by COMMUNICATING EFFECTIVELY IN INTERPROFESSIONAL TEAMS Recognize decline in vital signs Identify the rhythm Continue life-saving measures including CPR Provide for adequate cardiac compressions (2-inch depth on chest, 30 compressions to 2 breaths, 100 compressions a minute) May call for a defibrillator	PERFORMS INTRAVENOUS ACCESS, BASIC AND ADVANCED AIRWAY MANAGEMENT, MANAGEMENT OF SEDATION, AND BASIC AND ADVANCED CARDIAC LIFE SUPPORT ☐ adequate ☐ marginal ☐ none **Establish emergency, call for help**, call 911 ☐ adequate ☐ marginal ☐ none Perform heart and lung exam ☐ adequate ☐ marginal ☐ none **Check for a pulse** ☐ adequate ☐ marginal ☐ none **Identify the rhythm as asystole** ☐ adequate ☐ marginal ☐ none Place hardboard under the patient and **start CPR** ☐ adequate ☐ marginal ☐ none **Give patient an oxygen source via mask ventilation** ☐ adequate ☐ marginal ☐ none

(continued)

The patient is being ventilated less than adequately Analysis of the rhythm shows that it is not shockable Vital signs: no pulse, skin looks pink If not done, examiner asks trainee to secure airway with endotracheal tube	Direct resources in a code situation Continue life-saving measures including CPR Secure airway adequately and confirm placement with CO2 monitor, equal chest rise, or hearing of bilateral breath sounds	**Treat with epinephrine** <1 mcg/Kg (consider larger bore IV access) ☐ adequate ☐ marginal ☐ none **Check for pulse, resume CPR** ☐ adequate ☐ marginal ☐ none **Secure airway with endotracheal tube** (may use succinylcholine) and **confirm placement** (via CO2 absorber or assessing breath sounds) ☐ adequate ☐ marginal ☐ none
After epinephrine and multiple rounds of CPR, the patient is still in asystole	Know indications for Intralipid and correct dosing (Intralipid 20% 1.5 mL/kg over 1 min and then 0.25mL/kg/min infusion, may also repeat bolus, double infusion rate, or continue infusion × 10 min) Reassess patient frequently in order to LEARN AND IMPROVE AT POINT OF CARE	POSSESSES CLINICAL KNOWLEDGE OF INTERVENTIONAL PAIN TREATMENT in order to **Administer Intralipid intravenously** ☐ adequate ☐ marginal ☐ none
Paramedics arrive The patient appears to be recovering	Sign-out to paramedics should include procedure done, complications, vital signs, interventions, and patient history	TRANSITIONING PATIENTS EFFECTIVELY WITHIN AND ACROSS HEALTH DELIVERY SYSTEMS by Giving **sign-out** to paramedics and any further recommendations ☐ adequate ☐ marginal ☐ none ACCEPTS RESPONSIBILITY AND FOLLOWS THROUGH ON TASKS and EXHIBITS INTEGRITY AND ETHICAL BEHAVIOR IN PROFESSIONAL CONDUCT ☐ adequate ☐ marginal ☐ none WORKS EFFECTIVELY WITHIN AN INTERPROFESSIONAL TEAM and HAS PROFESSIONAL AND RESPECTFUL INTERACTIONS WITH PATIENTS, CAREGIVERS, AND MEMBERS OF THE INTERPROFESSIONAL TEAM and COMMUNICATES EFFECTIVELY IN INTERPROFESSIONAL TEAMS ☐ adequate ☐ marginal ☐ none END CASE = total points ______

The capitalized actions or assessments are competencies. Bolded items are considered actions critical for this particular scenario.
Source: [52].