Competency in anesthesia training for the performance of epidural insertions:

Does the evidence support a policy change?

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Capstone Project

DOCTOR OF NURSING PRACTICE

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Competency in anesthesia training for the performance of epidural insertions: A proposal for changing policy.

Abstract

**Background:** Currently at Texas Christian University’s (TCU) School of Nurse Anesthesia, there is not a set minimum number of epidural insertions required prior to graduation. There is a preferred number of epidural insertions set at 50.¹ **Purpose:** The purpose of this project is to determine if setting a minimum number of epidural insertions for TCU’s Nurse Anesthesia students will lead to increased competency in this technical skill. **Methods:** A literature review was completed to analyze the research regarding training and competency in epidural insertions. **Results:** There is currently not enough research to support a change in policy in the number of epidural catheter insertions required to graduate. It may also be necessary to evaluate this technical skill with objective, standardized grading criteria to ensure competency in epidural insertions.
Part One

Introduction

The ability to perform technical skills in the profession of nurse anesthesia is necessary to provide safe and effective anesthetic care for patients. It is believed that the most difficult technical skill is the ability to correctly insert an epidural. Currently the Council on Accreditation of Nurse Anesthesia Educational Programs does not have a set minimum number of epidural insertions to be eligible to sit for the certification exam. In contrast, the Residency Review Committee for Anesthesiology of the Accreditation Council for Graduate Medical Education has set the minimum number of performed epidurals at 50. However, this number does not have any supporting research to prove that competency is obtained in the practice of epidural placement by anesthesiologists. Furthermore, the method used by the American Board of Anesthesiologists to document the number of epidurals performed does not take into account any measure of quality regarding the performance of the skill. There are many complications associated with the insertion of epidural catheters. These complications include infection, trauma, postdural puncture headache, neurological injury, epidural hematomas, catheter misplacement, and backache. It is assumed that guidance in learning the skill of epidural insertions and practicing that skill will minimize these risks.

Many difficulties are associated with ascertaining the appropriate number of epidural placements needed to determine competency. Currently, emphasis on certification is centered on knowledge and judgment-based skills rather than technical skills. Also, there is currently no standard, objective assessment tool available to
determine competency or standard education regarding the process of epidural catheter insertion.\textsuperscript{7,8,9} With the increasing necessity to improve healthcare as a whole, it becomes vital to ensure that technical procedures, including epidural insertion, are safe and efficient.\textsuperscript{8}
Part Two

Literature

Background

It is within the scope of practice for the nurse anesthetist to place epidural catheters. However, the current guidelines for the training of anesthesia practitioners in epidural insertions as set by their governing bodies are not supported by evidence. There has also been a greater demand for a more objective measurement of competency for technical skills than a simple numerical requirement.

Methodology of Literature Search

The databases used to find relevant studies were PubMed, CINAHL, ScienceDirect, Academic Search Complete and Academic OneFile. The search terms used were Certified Registered Nurse Anesthetist (CRNA), anesthesiologist, novice, student, epidural, insertion, competency, training and assessment. Reference lists were also used to gather articles. As many of the articles found were older than five years, the cut off date was set at 1995. Articles that included data regarding the assessment of skills and the determination of competency were included. Articles that did not pertain to the skill of novices learning epidural insertion were excluded.

Literature Review

In two studies by Friedman, et al. a new assessment tool was used to evaluate competency. Though the main effort of their research was regarding aseptic technique, they also provide data focused on skill competency. Competency was determined through three scoring systems to evaluate sterility, safety, and dexterity. A skill checklist provided a step by step process in which each step was graded for a total score. The global rating
scale provided a more objective scoring process for the overall performance of the novice anesthesia provider. Friedman, et al. found a statistically significant strong correlation between the number of epidurals performed and the scores obtained on the assessment tools. Although this correlation was determined, the data was not used to determine a specific number of epidurals needed to determine competency.\textsuperscript{7,9}

Three articles focused on the use of a statistical method called the cumulative sum method. This method sets the number of acceptable failure rates. The cumulative score (cusum) increases with failure and decreases with success. The purpose of this method is to determine two points, 1) the point in which the actual failure rates are not statistically significant in regards to acceptable failure rates (i.e. competency), and 2) the point in which there is a statistically significant unacceptable failure rate. Furthermore, the goals of these articles were to measure competency on an individual basis and not to provide a recommendation on the minimum number of skills necessary to achieve competency. Failure for both articles was determined to be the inability to obtain adequate surgical anesthesia.\textsuperscript{11,12}

Filho used a sample of six residents and set the acceptable failure rate at 5%. The residents were scored individually and reached an acceptable failure rate at drastically different intervals ranging from 29 to 185 epidurals performed.\textsuperscript{11} Kestin also used the cusum method with an unacceptable failure rate of 10%. However, only two of the participants had data provided. One participant reached the point where there was no statistical difference between the actual failure rate and the acceptable failure rate at 47 attempts. The other participant had 185 attempts before he reached the statistically significant unacceptable failure rate.\textsuperscript{12} The third study to focus on the use of cusum
analysis set the unacceptable failure rate at 15%. The results from this analysis varied widely. One novice anesthesiologist was successful at every epidural performed. Another novice anesthesiologist was unable to achieve competency after performing 75 epidurals. The results of this study showed that competency was achieved between one and 85 epidural attempts.  

Two articles focused on the creation of a learning curve to ascertain competency in a group of anesthesiologists. The group learning curve was created based on the percentage of successes in the group and the number of attempts per anesthesiologist. Konrad, et al. also used success or failure to obtain data related to competency. Success without physical assistance from staff was scored as a 1. The need for physical assistance by staff or having the staff complete the procedure was scored as 0. For epidural insertions, a success rate of 80% for the group was reached at 90 attempts per each member of the group. A rapid increase in success was noted between the first and twentieth procedures performed. After this point, the success rate began to plateau.  

Similarly, Kopacz, et al. noted a rapid improvement in success rates in the first 25 procedures. He determined that 90% success was reached and maintained at 60 attempts. A 100% success rate without any assistance by staff was reached and maintained at 80 attempts.  

One study by Smith, et al. focused on measuring confidence levels of Anesthesiology residents. This survey was the only study that compared multiple training programs. The survey was taken by trainees in their first, second, or third year. They provided the number of cases they had performed and their comfort level with the skill of epidural insertion. By the third year of training, the interquartile range of the number of
procedures performed was 100-200. 96% of these trainees felt confident in their ability to perform an epidural insertion.\textsuperscript{4}

Another study focused on comparing the success rates of novice anesthesiologists. This study separated inexperienced trainees into four categories. Category IV trainees had performed 0-15 epidurals up to category I trainees with 45-60 epidurals performed. Again, the end-point for success was postoperative pain relief. This study found that category I trainees were able to place epidural catheters successfully on the first attempt and were able to do so in less time. Interestingly, this study found that there was no statistical difference between categories for accidental dural puncture.\textsuperscript{14}

In a study by Hayter, et al., the Imperial College Surgical Assessment Device (ICSAD) was used to monitor hand movements during the insertion of epidural catheters. Three groups were selected for comparison, a novice group who had performed less than 30 unsupervised epidurals, an experienced resident group who had performed over 100 epidurals, and attending anesthesiologists who had performed over 500 epidurals. The ICSAD was used in conjunction with an epidural checklist and a global rating scale to assess performance. The researchers found that novice practitioners required more time and more hand movements than the experienced residents and attending anesthesiologists. However, there was no statistically significant difference between the experienced residents and attending anesthesiologists.\textsuperscript{10}

One research study focused on psychomotor aptitude and skill with epidural insertions. This study evaluated ten anesthetic senior house officers who had no previous experience in epidural placement. Prior to performing epidurals, the house officers were tested with two computerized psychomotor tests. One test measured eye-hand
coordination and the second measured information management abilities. Correct placement of an epidural catheter was determined by success versus failure of establishing satisfactory anesthesia during the participants’ first 50 epidurals. This study found a significant correlation between failure rates and the test which measured eye-hand coordination for the last 25 epidurals. There was no correlation between the ability to correctly insert an epidural and the test that measured information management abilities. The authors hypothesize that spacial orientation and the ability to visualize the anatomy of the epidural space may be more important to obtaining competence in epidural insertions.  

Birnbach, et al. published an article researching the use of using video recordings of novice anesthesiologists to improve upon their skill. 22 anesthesia residents participated in this study. All of the residents were videotaped while performing epidurals throughout a 30 day period. Half of the residents watched their videos with an attending anesthesiologist and were asked to identify the technical errors they made. They then discussed their performance with the attending anesthesiologist. Residents were then evaluated for improved performance. On days 1, 15, and 30 of their rotation doing epidural catheter insertions, the video taken was reviewed by an independent judge. The judge scored 13 criteria using values of 0 (a major error), 1 (a minor error), and 2 (no error). An increase from one evaluation to the next of three points was deemed necessary to show an improvement in skill.  

The researchers found there was no statistical difference in performance between residents on the first day. By day 15, both groups of residents scored significantly higher. However, the group of residents who were able to review their videos scored higher (32)
than the control group (24). By day 30, the control group showed no improvement in scores (24) while the research group improved slightly (36). The number of actual epidural insertions was not included in this study.16

It is important to take emerging practices into account when researching this topic. The introduction of the use of ultrasound technology to provide a direct visualization of anatomical features may provide improvement in competency.17 The changes observed in pregnancy (e.g. increased body mass index and edema) may obscure anatomical landmarks.18,19 Two studies found that when using landmarks to identify the appropriate intervertebral space, many anesthesia practitioners inserted the epidural catheter in a different space. Schlotterbeck, et al. found that the clinically assessed intervertebral space correlated with the space found via ultrasound in only 36.4% of the studied patients. Out of 99 patients studied, six epidural catheters were inserted at the L1-L2 interspace. The use of this space carries considerable risk of neurological injury as the spinal cord may extend to L2.19 Another study found that ultrasound determination of the interspace used correlated to clinical assessment only 55% of the time. The researchers found that clinicians typically inserted epidural one or two spaces higher than the intended space.20

A study by Grau, et al. focused on the use of ultrasound in determining the intervertebral space and its effects on anesthesia. This study separated patients into an ultrasound group (n=150) and a control group (n=150). The researchers found that the use of ultrasound visualization increased the preparation time by 75 seconds. However, they found statistically significant decreases in morbidity with the use of ultrasound. The ultrasound group required less needle redirection, fewer puncture sites, and less catheter
insertion attempts. There was also a greater chance of incomplete anesthesia, side effects, postpartum headaches, and backaches in the control group.¹⁸

Another study by Grau, et al. focused on altering current teaching novice anesthesia practitioners by adding the use of ultrasound to identify the correct placement of an epidural catheter. Ten residents were separated into two groups. One group used an ultrasound guided technique and a control group used the traditional loss of resistance technique while learning how to insert epidural catheters. Success was defined as adequate anesthesia with a maximum of three attempts. Each individual performed 60 epidurals. Grau, et al. found that the control group reached a success rate of 84% ± 15% within 60 epidural attempts. The ultrasound group reached a success rate of 94% ± 9% within 50 epidural attempts.¹⁷

*Synthesis of Literature*

There is an apparent lack of research regarding the assessment of competency for CRNAs performing epidural insertions. Due to this lack, data regarding the assessment of novice anesthesiologists was obtained. The data available is difficult to synthesize due to the differences in end-points measured and assessment tools. There was also a wide variability within and between studies when determining the necessary number of epidural catheter placements needed to be declared competent.

The major finding of this research project is that it may be more important to use an objective evaluation tool as opposed to a minimum number of procedures.⁹ This is made especially clear in those studies that used the cusum method for evaluation of competency. Within all of these studies, a wide variability was noted for individual trainees’ ability to perform at a competent level.¹¹,¹²,¹³
Levels of Evidence Taxonomy

Refer to Table 1 and Table 2 of the Appendix.
Part Three

Intervention

Currently, the minimum number of epidural procedures is based on quantity.\textsuperscript{5} Due to the potential for individuals to learn at different rates, it may not be enough to define competence by the number of epidurals performed. This may necessitate the creation of criteria to measure learning outcomes.\textsuperscript{21} Competency may need to be determined by the use of assessment tools.\textsuperscript{7,9} Competency in epidural catheter insertion should not be based solely on a minimum number of skills performed, but also on technical fluency and flexibility.\textsuperscript{10}

The purpose of this paper is to propose a potential policy change of Texas Christian University (TCU) School of Nurse Anesthesia’s minimum requirements of epidural insertions. Although no clear recommendations are apparent based on the literature, this paper will outline the process of implementing this policy change.

The main intervention that emerged from the review of the available research is that more research is needed. However, for the purposes of this paper the intervention of a policy change will be explored. Currently, TCU does not have a minimum requirement for how many epidural insertions students must perform to graduate. For the purposes of this paper, the intervention will be to change this policy to require students to place 60 epidurals prior to graduation, with a preferred number of 80 epidural insertions.

The second intervention explored will be the creation of criteria to assess competency in epidural insertions. Currently, there is not a set of standard criteria to assess competency in epidural insertions.\textsuperscript{7,8,9} The requirement of performing a minimum amount of epidural insertions allows for exposure to the technical skill but does not, in
itself, ensure competency. The creation of this assessment tool is necessary to provide an objective assessment of competency. This tool should be used not only as a final determinant of competency, but also as a tool to evaluate progress and redirect the students away from errors when performing epidural insertions.

Steps to implement interventions

1. Determine the current guidelines regarding epidural insertions at TCU. Currently, TCU has no minimum requirement for epidural insertions and has a preferred number of 50 epidural insertions.  

2. Conduct a review of the literature regarding competency in epidural insertions. 

3. Create recommendations for policy change. These changes include setting a minimum number of epidural insertions required prior to graduation and the creation of assessment tools to determine if the student has achieved competency in the skill of epidural insertions. Possible assessment tools include:
   
a. The method of cusum statistical analysis. This tool requires an accurate log of successful and unsuccessful epidural insertions. This tool allows for ease of use and a minimum amount of data collection. However, due to the wide variability of when competency is determined using this tool, it may be an unacceptable tool if the student is unable to obtain enough epidural placements at his/her clinical site. 

b. The use of a skills checklist and global rating scale to assess competency. This tool measures competency regarding each step of the technical skill. However, it is more detailed and would require more time to complete than the cusum method.
4. Evaluate the potential increases in cost, time, and personnel required to implement the change in policy.

5. Evaluate the ability to obtain the minimum number of required epidurals at approved clinical sites. TCU’s School of Nurse Anesthesia currently tracks data through the use of an online tracking tool called Typhon. The Typhon data from 2007 to 2010 was analyzed to ascertain the average number of epidural insertions students obtained at their clinical sites. See Table 3.

6. Combine Steps 1 through 4 into a cohesive presentation.

7. Determine which person or persons are responsible for TCU’s School of Nurse Anesthesia policies.

8. Set up a meeting with the policy makers to discuss recommendations for policy change. If possible, also include clinical instructors for their expertise in training nurse anesthetists. Present the data and recommended interventions in a clear and organized manner. Explore the viability of the policy changes within this meeting. For example, ensure that it is possible for all students to meet the new requirements within their clinical settings.

9. Adjust the interventions as needed in response to feedback.

10. Once the change of policy has been approved, create a timeline for policy change. The ideal time to implement this policy change would be prior to students starting their clinical rotations. This allows for the time needed for students, faculty, and preceptors to adjust to the policy change.

11. Test the evaluation tool for clarity among different preceptors and validity.
12. Begin education regarding the policy change. Education should be provided to students, faculty, and clinical preceptors. This education should include the reasons why the policy was changed, what the new policy will consist of, and details regarding the criteria used to assess competency. It is necessary to educate clinical instructors and preceptors on the use of the criteria to prevent misunderstanding and ensure that fair and equal standards are set.

13. Assess the factors that may impede the ability to achieve these goals.

14. After the educational process has been completed, implement the new policy guidelines and the application of the competency assessment tool. As with many changes, there will most likely be additional concerns or setbacks during the implementation process. Be prepared to explore these problems and make changes as necessary.

15. Monitor the success of the intervention. For example, are students able to achieve the new minimum requirements?

16. Evaluate the outcomes of the policy change. This step will be explored later in this paper.
Part Four
Implementation and Results

Guiding Framework

The ACE Star Model

The model that will be used to implement these changes will be the ACE Star Model.

*Obtained from http://www.acestar.uthscsa.edu

Discovery

This stage is the “knowledge generating” stage through the use of primary research. The use of evidence-based practice has become more predominant in healthcare and this stage is very important. Though this paper does not undertake this step directly through the completion of primary research, the resulting evidence obtained by other researchers is necessary to identify an area of improvement.
Also, it is important to note that the ACE Star Model is a circular model. After the completion of the evaluation stage, it is necessary to start over with the discovery stage. Indirectly, the results of the interventions described above may contribute to this stage. One of the interventions described is the creation of an assessment tool to evaluate competency. After this tool is created, tested, and applied, the intervention and its outcomes can be disseminated to academic journals to add to the body of knowledge. This process allows for a sharing of the successes and setbacks of the policy changes.

Evidence Summary
The advantage to evidence-based practice is the process of summarizing and synthesizing the combined body of knowledge. By synthesizing the data, it is possible to diminish the potential for bias or errors and increases the reliability of the results. The process of synthesizing the literature into a single entity leads to the creation of interventions to positively affect the healthcare industry.  

A narrative review of the literature has been completed (Step 2) regarding the subject matter of this paper. Through the use of this technique, multiple sources were identified and combined to create a thorough picture of the current body of knowledge. This process identified possible (but not proven) interventions.

Translation
After completing the evidence summary, the information is translated into recommendations. These recommendations are represented above in Step 3 of the interventions. The evidence obtained through the literature synthesis and the recommendations created based on this evidence should then be organized and presented to policy makers. This process is represented by Steps 5 through 8. This stage is not
only important for the dissemination of knowledge, but also for the creation and presentation of the data. This process involves a clear, organized presentation of the summarized research and the resulting recommendations for change.

Another part of this stage is education (Step 8). It is necessary that the individuals affected by the changes made from the proposed recommendations understand the evidence and reasoning behind the change. Therefore, the condensed research data and resulting recommendations should be supplied to these individuals.

Integration

This is the stage in which the recommendations become policy.24 This stage corresponds to Steps 9 and 10. During this phase, it is important to continually reassess the ability of individuals to comply with the policy change.24

There are many factors inherent within change that may lead to an inability to achieve the goals set by the policy change. These factors include the necessity of multiple clinical sites and preceptors. There is a potential that certain clinical sites may not have opportunities to perform as many epidural insertions as are needed to achieve the new standards. Change is not always easy to accept. The interventions described above require more time and energy spent on achieving the goals set by the policy change.

Evaluation

This is the stage in which outcomes will be evaluated. During this stage it is necessary to have set end points to evaluate the effectiveness of the intervention.24 This stage corresponds to Steps 12 and 13.

Evaluation of the change in policy is needed to discover the success or failure of the change. A thorough evaluation shows not only whether or not the intervention was
successful, but also how to improve upon the process. Some questions that should be asked during this process are: Were the individuals affected by this change able to meet the goals? What barriers exist that affect the success of this intervention? Were these barriers overcome, or do they still exist? It is also important to obtain feedback from the individuals affected by this change to evaluate their perceptions.

Results

The results of this project would be analyzed in two ways. One, identifying if there was a successful implementation of new guidelines for TCU’s School of Nurse Anesthesia. This would be determined by a successful policy change to include the recommended minimum number of epidural insertions and the use of the assessment tool. Two, the assessment tool would be used to validate the new guidelines by ensuring that student nurse anesthetists are demonstrating competence in epidural catheter placements.
Part Five

Evaluation

The first outcome expected from this policy change is that the students are able to complete the minimum number of epidural insertions. This outcome will be evaluated through the use of recording the number of epidural insertions performed. However, this outcome only represents that students were exposed to the procedure, not that they have become competent in the skill. Therefore, a second outcome is also necessary.

The second outcome to be evaluated will evaluate the students’ competency in performing epidural insertions. This is the purpose of the evaluation tool that will be created. After the minimum number of epidural insertions has been reached, the preceptor will then evaluate the students’ competency. To further evaluate the effectiveness of this policy change, an informal survey will be used to assess the students’ and preceptors’ perceptions. This survey will include questions regarding the process of evaluation, barriers experienced during the change, and perceptions regarding competency.

Implications

Lessons Learned

The first lesson learned during the creation of this project is that though there is a strong need to improve the quality of care provided by new anesthesia practitioners, there is little evidence available regarding what is needed. It is surprising to see how little data there is regarding the complex and frequently used skill of epidural catheter insertions.

The second lesson learned was that there are many different ways to correct this deficit. As presented within this paper, many different researchers have proposed their own methodology to correct the inconsistencies noted in the training of new anesthesia practitioners.
practitioners. The availability of alternative solutions is appealing since one solution may be more effective than another. However, these alternative also created difficulty when trying to determine a definitive answer from the research.

**Future Directions**

As noted above, this intervention is not quite complete. There is no clear answer as to how many epidural insertions a student anesthetist should perform before being declared competent enough to graduate. The first step in altering this uncertainty is to create and publish more studies on the matter. A large, multi-site study would greatly add to this body of knowledge. The TCU School of Nurse Anesthesia would be an excellent site to complete this project due to the large number of students attending the school and the multiple clinical sites around the country.

It is strongly suggested that the use of minimum requirements for technical skills be used only as a guideline. This number should only provide a guideline for when students typically approach competency in a skill. A more accurate tool should be adopted to assess students’ competencies. This is shown by the large variations between and within studies as to when a novice anesthetist became competent with epidural insertions.
References


Appendix

Table 1: Level of evidence by article.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Level of Evidence</th>
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<tr>
<td>Konrad C., Schupfer G., Wietlisbach M., &amp; Gerber H.</td>
<td>1998</td>
<td>IV</td>
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<tr>
<td>Smith M. P., Sprung J., Zura A., Mascha E., &amp; Tetzlaff J. E.</td>
<td>1999</td>
<td>IV</td>
</tr>
<tr>
<td>Kopacz D., Neal J., &amp; Pollock J.</td>
<td>1996</td>
<td>IV</td>
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<tr>
<td>Friedman Z., Katznelson R., Devito I., Siddiqui M., &amp; Chan V.</td>
<td>2006</td>
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<td>Friedman Z., Siddiqui N., Katznelson R., Devito I., &amp; Davies S.</td>
<td>2008</td>
<td>IV</td>
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<td>Filho G. R. O.</td>
<td>2002</td>
<td>IV</td>
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<tr>
<td>Kestin I. G.</td>
<td>1995</td>
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<tr>
<td>Bould M. D., Crabtree N. A., &amp; Naik V. N.</td>
<td>2009</td>
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Table 2: Key to levels of evidence

<table>
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<tr>
<th>Level I</th>
<th>Description</th>
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<tr>
<td>Evidence from a systematic review or meta-analysis of all relevant randomized controlled trials (RCTs), or evidence-based clinical practice guidelines based on systematic reviews of RCTs.</td>
<td></td>
</tr>
<tr>
<td>Level II</td>
<td>Evidence obtained from at least one well-designed RCT.</td>
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<tr>
<td>Level III</td>
<td>Evidence obtained from well-designed controlled trials without randomization.</td>
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<tr>
<td>Level IV</td>
<td>Evidence from well-designed case-control and cohort studies.</td>
</tr>
<tr>
<td>Level V</td>
<td>Evidence from systematic reviews of descriptive and qualitative studies.</td>
</tr>
<tr>
<td>Level VI</td>
<td>Evidence from single descriptive or qualitative study.</td>
</tr>
<tr>
<td>Level VII</td>
<td>Evidence from the opinion of authorities and/or reports of expert committees.</td>
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<tr>
<td>Clinical Site</td>
<td>2007-2008</td>
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<td>-------------------------------</td>
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<tr>
<td>John Peter Smith</td>
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<td></td>
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<td>Naval Medical Center San Diego</td>
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<td></td>
<td>ANE: 36.8</td>
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<td></td>
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<td></td>
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<td>ANE: 16</td>
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<td>Hillcrest Medical Center</td>
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*N: Number of students performing epidurals at each clinical site. ANE: Average number of epidurals performed per student.