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Surgeons' performance during critical situations: competence, confidence, and composure

Katie Wiggins-Dohlvik, Ronald M. Stewart, M.D.*, Rachelle Jonas Babbitt, M.D., Jonathan Gelfond, M.D., Lee Ann Zarzabal, Ross E. Willis, Ph.D.

Department of Surgery, The University of Texas, Health Science Center at San Antonio, San Antonio, TX 78229, United States

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Abstract

BACKGROUND: Little is known about surgeons' performance during critical situations. We hypothesized that there are methods and techniques used by surgeons that facilitate performance during critical situations.

METHODS: Surgical faculty and senior general surgery residents from a single academic health center were surveyed.

RESULTS: Twenty-six surgeons participated. With respect to critical situations, the surgeons felt confident (96%), expected to be successful (96%), and most did not find these situations particularly stressful (62%). The majority reported using learned skills (92%) and agree their skills can be taught (82%). Practice and preparation were reported as very important (89%). A majority use pre-emptive visualization (68%). Competence, confidence, composure, preparation, and experience were most commonly listed as characteristics or behaviors that should be encouraged in aspiring surgeons. Anger, panic, indecision, fear, and chaos were the most commonly listed characteristics that should be discouraged.

CONCLUSIONS: Surgeons' response to performance under pressure is complex; however, surgeons report using simple, learned techniques that seem to be targeted toward eliminating the "fight or flight" sympathetic nervous system response.

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Approximately 20 million surgical procedures are performed each year in the United States, and 243 million are performed worldwide.^{1,2} Although the risk of complication is often very low, adverse events occur in 3% to 17% of cases,^{1,3} and it has been suggested that almost half of these events are preventable.³ Because of a strong desire to limit complications, especially preventable ones, much interest has been focused on improving surgical outcomes.^{4,5}

Currently, much emphasis has been placed on improving the dynamics within the operating room; the use of checklists, augmented communication, and the utility of pre- and postoperation debriefing sessions have recently been examined.^{4,6,7} Although strides are being made in improving surgical quality, surprisingly, little is known about the relationship between surgeons, stress, and performance under pressure.

Many believe there is significant variation among individual surgeon's performance during perioperative critical or stressful situations; however, this is mainly personal belief, and the fundamental factors underlying this presumed wide spectrum of responses are not studied. If differences do exist, they potentially have a profound impact

* Corresponding author: Tel.: +1-210-567-3623; fax: +210-567-0002.

E-mail address: stewartr@uthscsa.edu

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on patient outcomes; therefore, a better understanding of the mechanisms behind these differences is paramount. Indeed, other disciplines in which performance under pressure is often required have extensively studied factors and mechanisms that might lead to improved outcomes.⁸ There is a large amount of research examining performance in sports⁸⁻¹⁵ and aviation.^{6,16-19} Because neither of these disciplines is exactly analogous to surgery, further study of surgeons seems warranted.

We hypothesized that surgeons use techniques, perhaps similar to those used by athletes and aviation crew members, to facilitate performance under pressure. This pilot study aims to identify and characterize the methods used by surgeons to achieve optimal function during critical situations.

Methods

After obtaining institutional review board approval, an e-mail invitation to participate was sent to 27 senior general surgery residents and 43 faculty surgeons in the Department of Surgery. The e-mail explained the purpose of the study, provided informed consent for participation, and invited participants to schedule an interview time. Once scheduled, all interviews were conducted by 2 of the authors (KWD and RBJ). To maintain blinding, participants were assigned a participation identification number. A critical situation was defined as a situation in which (1) the patient's life or vital function was at risk, (2) the surgeon's intervention or critical judgment was required, and (3) the intervention was done under time-sensitive or adverse conditions. Participants were asked a series of approximately 57 questions read from a structured interview script. The structured interview collected demographic information and reported attitudes, knowledge, and beliefs regarding performance during critical situations. The questions were centered on the following areas: self-confidence, mental anxiety, physiologic stress, personality type, manner in which stress management skills were learned, manner in which surgical skills were learned, resident/trainee teachability, specific skills/strategies used to manage stress or enhance performance during critical situations, and general opinions on the field of surgery. The questions in the study have not been tested in a larger population of surgeons. After the survey, a series of questions were asked specifically encouraging the surgeons to speak in an open-ended manner. Qualitative information was obtained concerning strategies used during critical situations.

Descriptive statistics are reported for demographic characteristics. Questionnaire responses using a 5-point Likert scale were tabulated and reported as frequency (%). Based on the number of respondents, the margin of error on the knowledge, attitudes, and beliefs survey was $\pm 10\%$. Categorical data were analyzed by using chi-square analysis.

Results

Structured survey results

A total of 26 participants were interviewed over a 3-month period: 19 attending surgeons (73.1%) and 7 senior general surgical residents (26.9%). Of the 19 attending surgeons, there were 8 trauma, 3 cardiothoracic, 1 plastics, 3 transplant, and 4 general surgery faculty. This represents a 37.1% response rate (44.2% among attendings and 26% among residents). There were 4 women (15%) and 22 men (85%). The respondent's ages were categorized as follows: ≤ 35 years (31%), 36 years to 45 years (42%), and ≥ 46 years (27%). Participants reported their average weekly percentage of efforts (mean \pm standard deviation) as follows: clinical, 55 ± 26 ; administrative, 22 ± 17 ; teaching, 18 ± 13 ; and other, 7 ± 16 .

With respect to critical situations, the surgeons reported feeling confident (96%), expected to be successful (96%), and reported they performed well in these situations (96%). Most surgeons did not dread being involved in critical situations (96%), and, in fact, a large majority looked forward to participating in critical situations (73%). Most reported not finding these situations very stressful (62%); however, only a slight majority reported not feeling anxious before these situations (53%), and a high percentage agreed that they worried about a patient dying or suffering during the time of the situation (48%). A majority reported feeling relaxed during critical situations (56%), and only 32% reported they often notice signs of physiological stress. Most characterize themselves as people who plan ahead and are very goal oriented (92%), although 58% also agreed they enjoy living in the moment and look at unexpected things as a challenge. The vast majority reported they learned skills that have improved their ability to function during critical situations (92%) and also agree (81%) their skills can be taught. Surgeons unanimously agree that practice is valuable for critical situations, and they also agree pre-event preparation is very important (89%). A minority (32%) focus on the outcome of the procedure during its performance. Instead, most focus precisely on the technical aspects of the task during its performance (84%). A majority use pre-emptive visualization for critical situations (68%); however, this is significantly less than they report for elective situations (89%). When asked to list the 3 most important traits or emotions that should be encouraged in the aspiring surgeon, the top 5 words in order of named prevalence were competence, confidence, composure, preparation, and experience. Conversely, when asked to name the 3 most important traits or emotions that should be actively discouraged, the following words were most commonly named in order of descending frequency: anger, panic, indecision, fear, and chaos (Fig. 1).

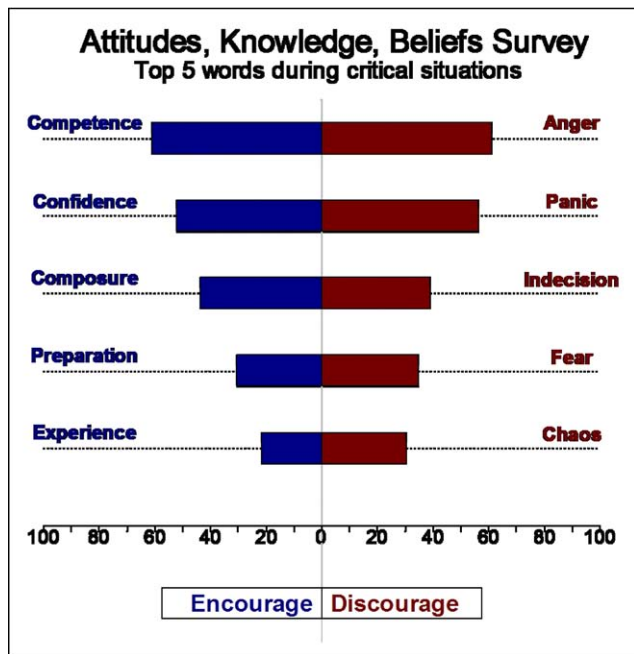


Figure 1 The percentage of responses named when surgeons were asked to name the top 3 traits or emotions that should be strongly encouraged or discouraged in aspiring surgeons.

Qualitative open-ended response results

Respondents who reported consciously using skills or learned techniques were asked to describe what specific skills they used? They were also asked to describe the most important techniques, tools, tricks, or strategies that they would pass along to aspiring surgeons? A range of different approaches were reported; however, in general, the respondents' techniques can be grouped into broad categories. Broadly, the skills used are related to (1) preevent preparation; (2) techniques learned from repeated experience; (3) personal emotional control, specifically avoidance of anger, panic, or fear; (4) environmental control, focus on maintaining a functioning team; (5) focusing on the big picture without getting lost in the excitement; (6) maintaining or restoring order and structure to the situation; and (7) maintaining confidence and composure. The following section contains excerpts of the actual open-ended responses as a composite from the surgeon respondents.

Preparation

"Definitely prepping before you do the case . . . Just always be prepared—read, read, read . . . to mentally prepare yourself for a critical situation, imagine yourself being in that position. Preparation is really visualizing the situation . . . Really imagining the situation, so you can really and truly prepare for those situations . . . To mentally prepare yourself for a critical situation, imagine yourself being in that position . . . if you go into uncharted territory, you would not want to be like this idiot who went out into the

woods in the winter and got cut off and starved to death, he did not bring maps, he did not know that a mile down the river there was a bridge for him to cross so he just starved, died. Well you go out in the wild, you have to be ready . . . the only difference is when you do something like that in surgery the patient dies."

Experience

"I have to be honest, there haven't been too many critical situations coming up that we haven't seen before . . . Just experience: that is not really a skill . . . but just calling on past experience . . . I think the skills I have used to prevent stress are purely a matter of self-taught trial and error . . . one of the most important things is experience, having experience and being involved in critical situations and learning . . . you know the more critical situations you can be involved in and the more you can learn from them; the more likely you are going to be able to handle a similar situation or other situations on the future. So it basically comes with time and experience."

Emotional control

"I have learned, and I do think this is learned, even though some would say it is innate, to control my emotions to a pretty high level. I think there are emotions that are detrimental to my own personal function and to the function of the team, and I believe these can be controlled or even eliminated—fear, frustration and fatigue—the 3 "F words" of technical procedures can and should be controlled. The reason I try to control those emotions is to avoid a physiological fight or flight response, which may be beneficial if you are running from a predator, but in surgery a fight or flight response is almost invariably hazardous to the patient's health because it adversely impacts the surgeon's performance. Fear, or maybe more correctly panic, is the most common initiator of this response. The reason I listed the three C's—confidence, competence and composure, is because these traits are an immunization against the negative effects of fear . . . To always take my own pulse first . . . do you know that? So I take a step back and go through the ABCs, you know the airway, breathing . . . eah, yeah you know. So I ensure I am calm and then systematically approach the patient . . . I have found that I will yell and scream from time to time in the OR, for effect. But if something is going to crap, I will not raise my voice and I will insist on perfect communication."

Environmental control

"I have learned to control the environment as much as possible. To me that is helpful. Although I think I can function well in an uncontrolled environment . . . I think I can function better in a calmer and more orderly situation. The optimum environment for those critical situations is a

calm relatively quiet environment where you can be relaxed enough to think about the patient . . . We sort of take an attitude of calming the room and then going back to first principles: stop the hemorrhage and you start the heart, whatever it is. It's kind of a straightforward approach and it's never improved by yelling and screaming . . . Frankly if the surgeon is calm, everybody is calm, and if the surgeon gets excited, everybody gets excited . . ."

Focus

"I step back from whatever it is we are dealing with either physically or make a mental note to step back. I then typically quiet the room. Then I systematically start at the beginning . . . Avoidance of tunnel vision, so looking at the entire big picture, prioritizing what things needs to be addressed in respect to this critical situation and recruiting the appropriate systems to get that done . . . Ability to focus on the most important matter at hand—in a larger picture that means triaging . . . I am methodical in my thought process and that makes me not stressed . . . Step back and see everything's covered and do a systematic evaluation. Then, do what you need to do . . . I think all 3 of those things are learned and important: controlling your environment, controlling your emotions, and thinking through steps to avoid certain situations."

Restoring order

"Trauma surgery is making order out of what is inherently a disorderly situation . . . You have to be calm in chaos and you cannot let the situation control you, you have to control the situation, and believe in yourself. You know what to do: do it . . . Transform, try to transform, an emergency situation into a semi emergent one. Try to organize yourself and see in steps or systematically visualize what you are going to do."

Confidence and composure

"Confidence, competence and composure are an immunization against the negative effects of fear . . . Composure and confidence: you have to really believe in your skills and work on your skills . . . Confidence in what you know and just staying calm in a stressful situation because that helps you think . . . Maintain focus and maintain composure. I think you can think clearer if you maintain some sense of internal order in your own head . . . To me, believing you can do it is basic planning—confidence serves the surgeon as the blueprint serves the carpenter. Confidence means you believe you will be successful in this situation. It may not be true, but it is still essential. Some things may not always be true, but still are very important to believe, and for a surgeon, confidence is one of those things. You may not be successful, but you better believe you will be successful. If

you are not confident (planning to be successful), it is surprising how frequently you are unsuccessful."

Comments

Principal findings

The surgeons' response to performance under pressure is complex (Fig. 2); however, surgeons report learned strategies that can be used to improve performance. Preparation, practice, and pre-emptive visualization are important tools. The participants listed competence, confidence, and composure as attributes to be strongly encouraged in trainees, whereas anger, indecision, and panic were listed as attributes to be strongly discouraged (Fig. 1). Surgeons participating in the survey reported actively using a range of skills to enhance performance during critical situations. These include focusing on (1) pre-event preparation; (2) techniques learned from repeated experience; (3) personal emotional control, specifically avoidance of anger, panic, or fear; (4) environmental control, focus on maintaining a functioning team; (5) focusing on the big picture without getting lost in the excitement; (6) maintaining or restoring order; and (7) maintaining confidence and composure.

Comparison to previous work

In athletics, there are numerous factors that determine or affect an individual's performance. Physical fatigue after high-intensity exercise has been shown to have negative effects on both perceptual and motor control in the execution of sports-specific tasks.¹⁹ At very high levels of physical exertion and arousal, maintenance of attention on critical task specific information protected athlete's performance from deterioration.⁸ The influence of motor imagery has been linked to improvements in muscular strength, power, and work capacity that equal improvements made by action training of identical tasks.⁹ These data seem to be consistent with the commonly reported practices of surgical pre-emptive visualization and the focus on the technical details during a critical situation. Specificity of learning conditions also appears to be related to athletic performance, holding specific application to performance in high arousal situations. Athletes who perform tasks under pressure show significantly higher levels of skill execution when they are tested in situations that mimic the circumstances under which they were trained.¹⁰ Additionally, an athlete's perception of stress as either facilitative or debilitating has been shown to moderate competitiveness as well as performance.^{11,12} Differences in an individual's personality have been linked to varying degrees of physiological responses to stress,¹³ reinforcing the link between personal perception and function in high arousal situations. In addition to stress perception, an athlete's awareness of his/her physiological response to arousal, such as noticing an increased heart rate,

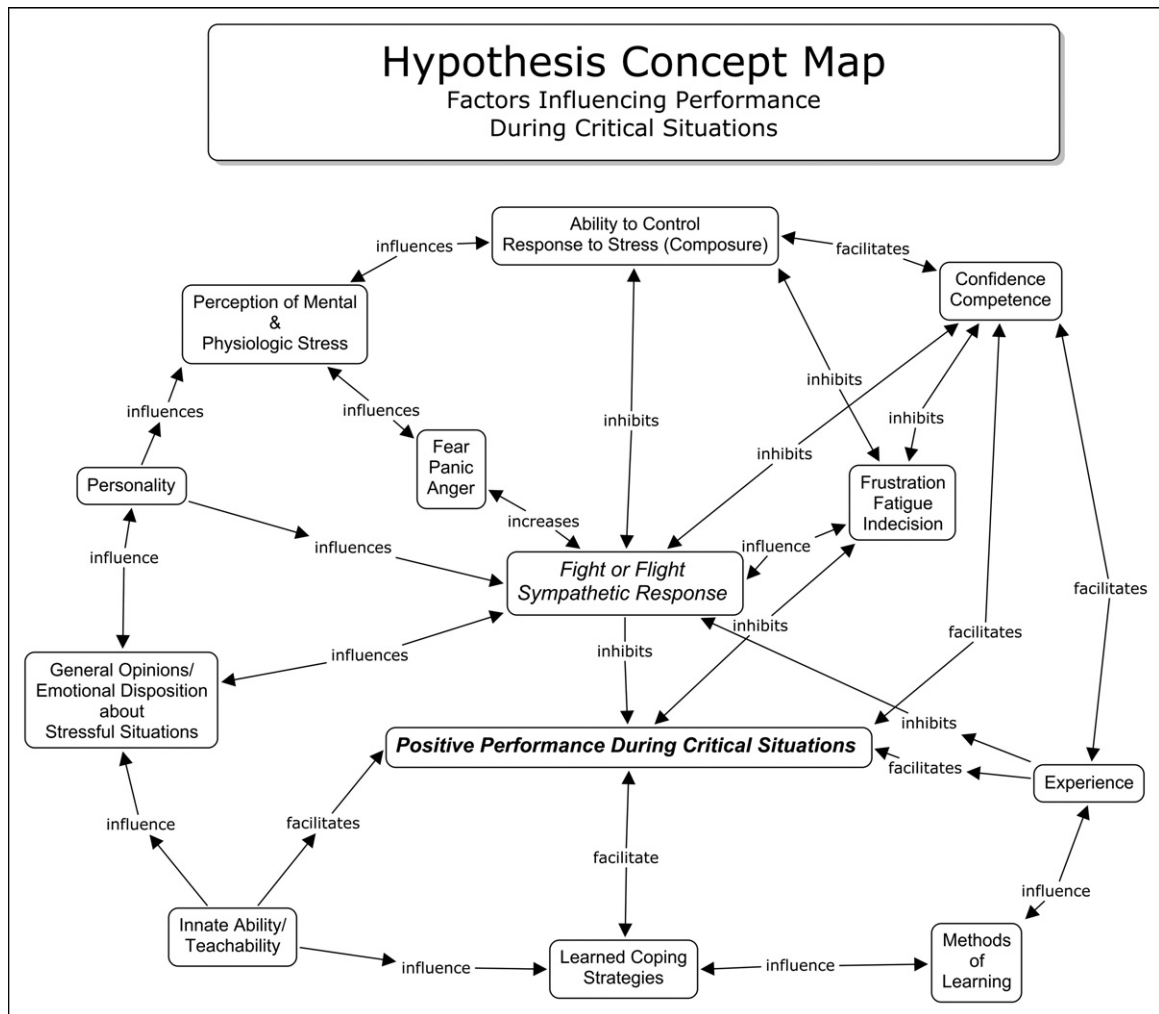


Figure 2 A hypothesis concept map of factors influencing effective performance during critical situations.

can greatly affect performance.⁸ It has been proposed that when sports skills are learned in an implicit fashion, rather than explicitly, automated routines are developed and these are protective of function in high-pressure situations.¹⁴ This idea has been explored further in the field of surgery showing that when a surgical skill is learned in an implicit and active fashion, fewer errors are committed and performance is more stable when multitasking than if a skill is learned through verbal instructions.¹⁵

For over 2 decades, the aviation industry has taken extensive measures to reduce errors and improve functioning to ensure safety: 1 such avenue is a training program called crew resource management. These training programs aim to (1) avoid errors, (2) trap incipient errors before they are committed, and (3) mitigate consequences if errors occur.¹⁸ It has been shown that air crew error and performance can be specifically affected by communication and coordination; leadership, responsibility, and task delegation; and recognition of stressors that affect performance.¹⁶ Training programs such as crew resource management, with specific emphasis in the areas of interpersonal communication, leadership, decision making, conflict resolution, and stress man-

agement, are positively received by air crew members and can increase crew coordination and performance.^{16,17} The similarities between medicine and aviation make it likely that medicine can glean important insight from aviation's investigation into performance under pressure.¹⁹

In fact, air crew's attitudes on stress, errors, and teamwork have been compared with those held by medical professionals (surgeons, anesthesiologists, and internists).^{6,19} Although both found communication important and pre- and postsituation debriefings helpful, there were marked differences in attitudes regarding stress; surgeons were much more likely to deny the effects of fatigue and stress on performance, they were more likely to view their communication as a positive factor than those around them, and medical professionals in general were less likely to accept personal susceptibility to error.⁶

Limitations

Our data have significant limitations because of a small sample size and a focus on a single institution; therefore, the survey may suffer a low degree of external validity. This

work does illuminate the potential for improving surgeon performance during critical situations. Of course, this study also relies solely on self-reporting from the surgical respondents, but it serves as a starting point for observational and even interventional studies of this topic.

Synthesis and Conclusions

In a way, some of the findings from this survey appear to be ridiculously self-evident. No rational person would argue that chaos, panic, indecision, and anger would be positive attributes in any work environment, much less the operating room. And, conversely, the average lay person would surmise that competence, confidence and composure, preparation, and experience would be beneficial to functioning in almost any setting including surgery. These are simple concepts; however, in life and death critical situations, we argue that these simple attributes often determine success or failure and that without active management chaos, fear, and panic can quickly creep into these situations.

Also, what seems simple on the surface begins to look more complex when the concepts are mapped together as in [Figure 2](#). The concepts are simple, but the interactions are complex. When the survey responses and comments are synthesized, we believe they reveal a unifying hypothesis for future study. The experienced surgeon does indeed use a wide range of simple techniques to improve function when it matters the most. But at the root of it all, why are the surgeons managing themselves and their environment so carefully? We hypothesize that most of the strategies used during critical situations have a common goal of preventing or limiting a “fight or flight” sympathetic response from the surgeon or the surgical team. A full-blown sympathetic nervous system response is detrimental to skills requiring fine motor skills or refined judgment. We believe that surgeons, either through explicit understanding, training, or intuition, appear to understand the detrimental consequences of this most basic physiological response and, subsequently, take multiple steps to prevent or eliminate the response. In an interesting way, many of the respondents seem to construct a psychological shell around themselves where they can optimally function, even though the environment or situation may not be conducive to calm, methodical behavior. A number of the participating surgeons also describe extending this management to those around themselves.

So, although the interactions are complicated and under the influence of multiple factors, surgeons report using simple, learned techniques that seem to be targeted toward eliminating the “fight or flight” sympathetic nervous system response in themselves and those around them. Further understanding of this process may lead to broader, earlier, and more uniform dissemination of these techniques to aspiring students of surgery.

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Discussion

Vafa Ghaemmaghami, M.D. (Phoenix, AZ): I would like to congratulate the authors for a well-written article on a thought-provoking topic. You have reaffirmed one of my long-held personal beliefs; it is not what you do, it is how you do it. I would also like to thank you for refuting one of my least favorite movie producers, who famously stated,

“80% of life is just showing up.” In general, we tend to get not what we deserve in life but what we expect. Ask a successful hitter in baseball about what he thinks when he steps to the plate and you will probably hear “this one’s going over the fence”; the truth is that the best hitters make an out 2 out of 3 times at bat. Surgical performance and proficiency, as pointed out by the authors, are complicated processes to study. I commend you on providing some insight to the thoughts and attitudes that factor into success in our profession; it is no doubt a service to professionals in other demanding fields. I have a few questions: the first involves external validity. Where did your survey questions come from? Have they been validated by professionals in disciplines with expertise in this type of analysis? Second, you mention that many of these skills can be taught. Have you done this at your institution? If so, how? Lastly, how do we take your results and move forward? That is, what concrete steps do you recommend to us in the teaching environment to help our trainees improve their performance in critical situations?

Katie Wiggins-Dohlvik, M.D. (San Antonio, TX): Thank you for those comments and questions. As for the external validity, this was a pilot survey, so we took things that we identified in the aviation or the sports arena and formulated questions based on those, realizing this is sort of an apples to oranges comparison. We also included many open-ended questions to try to capture anything that surgeons do that might be specific to the arena of surgery. So, this pilot study does suffer from a lack of true external

validity. Your second question talked about how can the skills be taught; are they being taught in our institution? Currently, we have not made any changes. This was a pilot survey to kind of test the water I guess because there is so little information looking at this in surgeons, and, so after our follow-up, we hope that it can be implemented. As to your third question how to do that? I can only speak from a medical student point of view, so I do not really have an answer, but for myself, just knowing that there are things you can do when you enter the operating room in your third year is helpful, and, so having an idea to be confident, know as much as you can. That’s helpful. I do not know of a specific way to incorporate that into the curriculum, but hopefully it can be one day once we understand the process a bit better.

Robert Feldtman, M.D. (Buckholts, TX): I want to congratulate you all on writing an article that I think is extremely important. I have never heard this topic discussed at a national meeting before, but everybody in the room needs to realize, in Texas at least, the State Board of Examiner will take away your medical license for disruptive behavior. And I have seen names of friends of mine who have had sanctions against them because of disruptive behavior. JCAHO now requires that we be trained in techniques to avoid disruptive behavior, so I think that we are going to look very much forward to Ronny Stewart and stay on this further in San Antonio and hope that maybe this can generate similar studies and may be cooperative studies with you guys. Excellent topic!