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Crew Resource Management Training for Nurse Anesthesia Education

John P. Lonneman

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by

John P. Lonneman

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Abstract

Communication errors have been identified by The Joint Commission on Accreditation of Healthcare Organization (JCAHO) as the leading cause of wrong site operations and other sentinel events (Makary et al., 2006; Neily et al., 2009). Additionally, poor teamwork in the OR results in higher morbidity and mortality (Mazzocco et al., 2009). The aviation industry has used the concepts of Crew Resource Management (CRM) for more than 20 years to reduce accidents caused by human factors (Rivers, Swain & Nixon, 2003). CRM focuses on communication, leadership, decision making and resource management to achieve safe outcomes. CRM has been shown to lower the rate of surgical deaths in hospitals that have implemented training programs (Neily et al., 2010). A review of current literature was performed to identify the success of CRM in aviation, the role of CRM in healthcare and barriers to CRM implementation. The objective of the paper is to identify support for CRM training during nurse anesthesia graduate education.

Crew Resource Management Training for Nurse Anesthesia Education

The deadliest accident in aviation history claimed the lives of 583 people on March 27th, 1977. Two Boeing 747 jumbo jets collided on a runway on the Spanish Island of Tenerife off the Northwest coast of Africa. Factors contributing to this accident included poor crew communication, a hierarchical culture where subordinates were intimidated if they spoke up during critical times, and the presumption that senior leaders were less likely to make mistakes than their inexperienced junior team members (Nance, 2008).

Similarly, the medical community is burdened with a hierarchical regime where senior leaders are presumed to be infallible and communication errors are a leading cause of medical errors (McGreevy et al., 2006; Sutcliffe, Lewton & Rosenthal, 2004). While the aviation industry has decreased errors from human factors by up to 81% through the use Crew Resource Management (CRM), the errors in healthcare continue to mount. The loss of lives from preventable medical errors is estimated between 44,000 and 98,000 people every year while the financial impact is estimated to be between $17 billion and $29 billion per year (Kohn, Corrigan & Donaldson, 2011; Rivers, Swain & Nixon, 2003). Extrapolated to aviation statistics, this is akin to 200 jumbo jet crashes per year, or a 747 crash every other day (Stahel, 2008).

A decade ago, the Institute of Medicine (IOM) published a report, *To Err is Human: Building a Safer Health System.* The report demanded that improvements be made to decrease medical errors by 50% within in five years and called on healthcare organizations to take steps to implement teamwork to achieve safe patient care. Ten years later, patient safety has actually gotten worse (Clancy, 2009). The Joint Commission on Accreditation of Healthcare

Organization (JCAHO) has listed communication errors as contributing to over 70% of sentinel events in 2005 (Greenberg & Regenbogen, 2007). Other studies have shown that of errors occurring in the operating room, the root cause of events was found to be communication breakdown (Neily et al., 2009).

Team work and communication is important in all areas of healthcare, but of paramount importance in the surgical setting. The operating room is a dynamic and fast paced environment where precise communication is essential but often difficult. Nonverbal communication clues are obscured by surgical masks, while equipment noise and loud music further complicate communications among team members (Powell & Hill, 2006).

After the IOM report was released ten years ago, Congress appropriated $50 million dollars and set out a plan to improve patient safety that emphasized leadership, team training, and proven safety strategies. Tasked by congress to lead the national effort to improve patient safety, the Agency for Healthcare Research and Quality (AHRQ) was appropriated an additional $245 million in the next five years following a blueprint laid out by the IOM . The plan called for healthcare organizations to implement team based interdisciplinary training, improve leadership and develop a system of non punitive error reporting (Bleich, 2005). The IOM suggested the use of CRM to reduce medical errors and improve patient safety (Zeltser & Nash, 2010).

CRM was pioneered by the National Aeronautics and Space Administration (NASA) and a joint venture with the airline industry in the late 1970's. CRM training focuses on the principles of decision making, leadership, team training, communication, situational awareness, and workload management to create positive outcomes (Healy, Barker, & Madonna, 2006; Zeltser & Nash, 2010). Research into aviation mishaps determined that greater than 70% of crashes were caused by bad decisions, poor communication among team members and

inadequate leadership. Likewise, failures in communication have been identified as the cause of greater than 60% of sentinel events in healthcare in which 74% of the patients died (Powell & Hill, 2006) and as a leading cause of adverse events during surgery (Awad et al., 2005).

Purpose

The purpose of this paper is to identify through a review of current literature, the evidence that supports implementation of CRM and team training type concepts for nurse anesthesia education. Although CRM type principles are being used in hospitals at present, it has been difficult to effect a change in a culture where traditional hierarchies are in place. The present healthcare system is filled with highly trained, highly skilled personnel who work in a team setting, but are trained to function as individuals.

Furthermore, the environment in the healthcare setting follows a hierarchy where communication is hindered because team members are not encouraged to speak up or are afraid to challenge a presumed position of superiority (McGreevy t al., 2006). In order to effect a cultural change it must start during the primary years of education (Lerner, Magrane & Friedman, 2009; Staender, 2010). The literature review will serve as a guide in making recommendations to improve clinical practice by exploring evidence supporting the use of CRM for nurse anesthesia education.

Significance

The IOM, in 1999, acknowledged that more deaths occur from medical errors each year than from the combination of motor vehicle accidents, AIDS and breast cancer. Furthermore, an American College of Surgeons closed claim study found that communication breakdowns contributed to greater than 85% of adverse outcomes (Stahel, 2008). CRM has been a tremendous asset to the aviation industry, reducing accidents by up to 81% (Rivers, Swain &

for example, work closely with anesthesiologists, surgeons, operating room nurses, post-anesthesia care unit nurses, pharmacists and many other health professionals every day. Although each professional has specific duties to accomplish, all are working together for the benefit of the patient. Healthcare and the aviation industry both strive for the ultimate goal of safety, and teamwork is the central theme touted by the IOM to improve patient safety. It is logical, then, to examine a framework based on team development.

In 1965 an American Psychologist, Bruce Tuckman, published a theory of group development that laid out the stages that teams must transition through in an effort to tackle problems, work together to find solutions and ultimately grow as a team. Tuckman hypothesized that there are four stages of team development that group members must progress through before finally coming together as a fully functional team. The four stages are known as forming, storming, norming and performing. Tuckman added a fifth stage, adjourning, in 1977. (Riebe, Roepen, Santarelli, & Marchioro, 2010).

Stage one, forming, is the time for meeting other members of the team and getting to know one another. In this stage each team member is goal oriented while seeking to avoid conflict. Individuals are concerned what others think of them and meeting new friends is important during this stage. The leaders of the organization are tasked with providing much direction during this stage as individuals are not working for the good of the team. Little work is accomplished in this stage of politeness where all team members strive to avoid conflict.

Stage two is known as storming. Characterized by conflict, team members begin to question other members in the group and even the team leader. Interpersonal relationships may suffer as team members start to question how things are being done to accomplish the task at hand. Power struggles exist during this stage and compromise must take place.

In stage three, norming, relationships begin to develop once again and the team members work together to solve problems while still taking direction from the group leader. Although the unity is becoming stronger, the group is not able to fully function on its own.

The fourth stage, performing, is characterized by a fully functional team that is task oriented with little direction from the team leader. Team members trust each other and work together to complete the assigned task. Any disagreements that might arise are dealt with in a positive manner by the team as a whole. Loyalty, commitment, internal accountability and efficiency are key aspects of the performing stage.

Tuckman added a fifth stage to his theory in 1975, known as the adjourning stage. The team has accomplished the task and is ready to move on to new challenges. Team members can discuss the success they had in accomplishing the task while also reviewing what mistakes were made along the way. This stage provides an opportunity to debrief after completion of the intended task.

Although Tuckman's theory of group development perhaps overly simplifies the dynamics of a group, the model does a nice job of portraying the stages that groups transition through while trying to solve problems. Tuckman's theory is useful in looking at CRM training for nurse anesthesia education because CRM focuses specifically on working together as a team to safely accomplish tasks.

Definitions

Crew Resource Management: The effective use of all resources to achieve safe and efficient outcomes. CRM focuses not on the technical skills and knowledge necessary to accomplish a mission, but instead on interpersonal and team building skills. Elements of CRM include communication and decision making processes, teambuilding, situational awareness,

workload management, resource management, avoidance of distractions and prioritization of tasks. Processes such as SBAR, an acronym for Situation-Background-Assessment-Recommendation, are included in CRM training to teach members to communicate clearly and concisely (Healy, Barker, & Madonna, 2006; Seago, 2008).

Communication: Two or more team members sending and receiving commands and providing feedback to each other (Powell & Hill, 2006).

Human Factors: Reducing human error by combining the fields of social sciences, physiology, and engineering in an effort to determine what variables affect individual and team performances. Human factors are the study of how people interface with machines and each other. Elements of human factors include displays, controls, alerts, alarms, communication, work space and procedures (FAA advisory circular, AC-120, FAA safety system handbook).

Teams & Teamwork: Two or more individuals whose purpose and goal is common, have similar skill sets and hold themselves accountable while collaborating with one another to achieve the best possible outcomes (Goldfarb & Lanken, 2010).

Process

In conducting a comprehensive review of the literature, a search of the following electronic databases was performed: CINAHL (Cumulative Index to Nursing and Allied Health Literature), PubMed, Scopus, and PsychINFO. Keywords utilized in the search were: crew resource management, crew resource management training, team training, medical education and CRM. Scopus provided the largest number of journal results with 18756 when keyword team training was searched. Results were reduced to 88 when searching within the results using the terms CRM and medical education.

Scopus also returned 602 articles with keyword crew resource management and narrowed to 97 articles with searching medical education within the results. CINAHL provided the least number of articles with 62 results, while PubMed provided 111 results with keyword crew resource management and 111 with crew resource management training. PsychInfo returned 128 articles with keywords CRM and medical education. Overall search of all databases included an overlap of some articles and revealed a limited number of articles regarding the use of crew resource management for medical education and no results for CRNA education.

The information, revealed through a comprehensive search of electronic databases, will be utilized in an effort to determine support for implementation of crew resource management principles into CRNA training and education. Implementation of CRM into CRNA education will enable beginning anesthetists to communicate effectively and maintain situational awareness in the demanding field of anesthesia. Learning the principles of CRM during the formative years of initial training and education will also provide student nurse anesthetists and new graduates with the mindset to effect the cultural change which is necessary for CRM to be effective in the medical arena.

Review of the Literature

Should CRM training be implemented into educational curriculum for nurse anesthetist education? In order to answer this clinical question a link between aviation and healthcare must be established and the success and failures of CRM in the aviation industry must be examined. In both aviation and medicine, failures often result from human factors.

Impact of the Use of CRM on Aviation.

The deadliest accident in aviation history happened just off the Northwest coast of Africa in 1977. Senior Captain Jacob Van Zanten, Chief Pilot and Director of Safety for KLM Royal

Dutch Airlines with 30 years of seniority was under pressure to maintain a schedule and avoid the cancellation of his flight. One hastily made decision by Van Zanten to take off without proper clearance, combined with foggy weather and the inability of his flight crewmembers to effectively question their presumed infallible Captain, resulted in the collision of two fully loaded 747 airliners and the deaths of 583 people (Nance, 2008).

There were many factors that contributed to this accident but a primary contributor was the failure of the flight crew to directly question the authority of the captain for fear of reprisal. The hierarchy of the airline industry at the time of the accident dictated that senior leaders are presumed to be flawless unless proven otherwise. Subordinates were not so much discouraged to speak up but instead were following what is known as the halo effect. This is "the tendency to believe that someone more experienced and senior could not be wrong and you be right." Respected leaders are viewed as having halos over their heads because of the positions they hold (Nance, 2008).

CRM, since its inception, has made great strides in changing this type of mindset in the aviation industry. In the period from 2001 to 2006 there were zero deaths among major airlines; in that same time period there were an estimated 250,000 to 500,000 deaths in American hospitals from medical mistakes (Nance, 2008). The culture created through CRM training allows crewmembers to freely offer input and use assertiveness skills without fear of being ridiculed by senior or authoritative figures, i.e. the Captain of the airplane. At the same time, the Captain invites input while maintaining expectations from his crew that they will speak up if anything seems unusual or incorrect in the operation of the airplane (FAA Advisory Circular, 2004).

Communication is the key element for CRM to be effective. Use of standard phraseology and terminology creates a common language that eliminates the chance of errors. "Openness, candor, honesty, trust and spontaneity are critical skills. Poor crewmember communication can lead to misunderstandings that may result in crewmember error. Effective communication requires skill in crewmember communication, inquiry, advocacy, and an awareness of potential communication barriers" (United Airlines Inc., 2008). CRM integrates the technical skills of flying airplanes with the human factors involved in every day flight operations to reduce threat and errors.

Although CRM has met with success in the aviation industry, that success did not take place overnight and is continually being developed. The roots of CRM can be traced back to a workshop sponsored by NASA in 1979. The workshop, which focused on examining pilot error, revealed that the cause of many air transport accidents can be attributed to deficient leadership, poor decision making, and interpersonal communication failures. Out of this conference came the term Cockpit Resource Management (CRM)

Two years later, United Airlines initiated the first CRM training for airlines utilizing outside consultants. The training was heavy on managerial styles and psychological testing, attempting to correct individual leadership styles. Some in attendance called the new training, "Charm School," while others felt it was an attempt at changing their personality (Helmreich, Merrit, & Wilhelm, 1999.)

CRM continued to evolve over the years, and by the mid the late 1980's most commercial airlines had instituted the training. Team building and group dynamics became more of the focus of CRM training and the Federal Aviation Administration (FAA) mandated that flight attendants partake in this training. The name of the training program changed at this point from Cockpit

Resource Management to Crew Resource Management. CRM gained acceptance during this period and branched out to other disciplines including flight dispatchers and maintenance personnel. Still, this 3rd generation of CRM was heavy on group dynamics and participants called the training "psycho babble" (Helmreich et al., 1999).

As CRM continued its evolution, the FAA began to require airlines to develop their own training programs and mandated that the training be integrated into the technical aspect of the flight crew training. Simulator training focused not just on how to deal with technical failures but handling them as a team and using all available resources to best manage the problem (Helmreich et al., 1999).

CRM, now in its fifth generation of development, holds as it tenet that errors due to human interaction are inevitable and the key to success lies in finding ways to mitigate human error as much as possible (Salas, Burke, Bowers & Wilson, 2001). CRM has been recommended by the IOM as a way to improve patient safety (France et al., 2005) but evaluating just how effective CRM has been in the aviation industry has proven to be quite difficult.

Barker (2007) states that in 2001 there were only 2.6 accidents per million flight hours flown which leads to the assumption that CRM has improved airline safety. FAA regulations prohibit the implementation of CRM at one airline and not at another and then comparing accident rates at some later point. Thus, the hard evidence for CRM's success is difficult to ascertain. It is only anecdotal evidence that shows that CRM improves safety.

Salas, et al. (2001) examined 58 separate aviation studies in an effort to determine the effectiveness of CRM training programs. The studies involved mainly commercial airline pilots and military aviators with a mix of general aviation and student pilots. Kirkpatrick's framework was utilized for evaluation of the CRM training. Three distinct characteristics are included in

Kirkpatrick's framework: participant reactions to training, whether desirable changes in behavior took place and if participant learning was enhanced and carried over to everyday life.

Participants in 44% of the studies felt that the training was worthwhile and liked the training. The importance of this cannot be overlooked because it is the attitudes of the participants toward training that earn support for the training from the top levels of the organization.

Evaluation of behavioral change assessed by attitude questionnaires, in the majority of the 58 studies, revealed positive attitudes toward CRM training although these attitudes tended to decline over time. Again, support from upper management is imperative for the continued success of CRM after training takes place (Salas et al., 2001).

Finally, most studies indicated that participant behavior during simulated situations showed marked improvement. However, because FAA regulations prevent monitoring the behavior of flight crews during actual every day flight, it is difficult to obtain an accurate assessment of how well the training actually carries over to the flight deck (Salas et al., 2001).

The highest level of evaluation in Kirkpatrick's framework is the impact to the organization. In the case of CRM training, how was safety improved and by how much? The answers to these questions are not straightforward. Anecdotal evidence or longitudinal studies are essentially the only means to truly assess the effectiveness of CRM. Only six of the 58 studies examined this key piece of information due to several reasons. First, because accidents occur infrequently, the impact on safety to the organization is not often sought and the information is extremely difficult to collect. Additionally, accident and incident reports provide subjective evidence that perhaps CRM played a role in decreasing the magnitude of human errors but concrete evidence is still lacking.

Longitudinal studies are yet another way to assess the impact that CRM has on organizational safety, however, these studies take time and there is often no control group with which to compare the results. Overall, most studies indicated that CRM made a difference in safety outcomes, but the evidence is simply not concrete and more work needs to be done to provide a firm link between increased organizational safety and CRM. Recommendations included more evaluations at multiple levels and several measurement modalities instead of the typical attitude questionnaires. (Salas et al., 2001).

Application of CRM in the Surgical Setting.

While the debate regarding the effectiveness of CRM in the aviation industry continues, Hunt and Callaghan (2008) believe that trying to apply the principles of CRM to the surgical setting is too simplistic of a solution. The hierarchy in aviation is clear cut with the Captain of the airplane being the authoritarian figure, whereas in medicine the pilot in command (PIC), so to speak, is not easy to discern in a room where everyone is dressed alike with sterile coverings; this confusing environment of the operating room leads to uncertainty during emergencies and delineating clear roles for staff.

Surgical human factors are also different than those found inside the cockpit and thus more evidence is needed before implementing principles that show only anecdotal evidence of being successful. The skill sets, knowledge and experience are different for surgeons. This is unlike the numerous similarities found between different aircraft that pilots fly over the course of their careers. Finally, the decisions made in medicine are often influenced by the wishes of the patient, their family and even societal values unlike the decisions made by the PIC who need not consult the passenger in the back of the airplane before making a decision (Hunt & Callaghan, 2008).

The concepts of CRM have been widely utilized in the healthcare arena and numerous studies have looked at the impact that CRM training has had on the attitudes of hospital staff and culture, as well as perception of teamwork, communication and hierarchy (France et al., 2005; Gore et al., 2010; Makary et al., 2006; Sexton, Thomas, & Helmreich, 2000;).

Using safety attitude questionnaires as the primary method, researchers determined that the perception of communication and teamwork was definitely skewed. Surgeons rated the level of teamwork among themselves as very high and believed that the teamwork among the entire OR staff was also very high. Nurse Anesthetists also rated teamwork among themselves and anesthesiologists as high but felt that teamwork with surgeons and surgical staff was low. (Makary et al., 2006; Sexton et al., 2000). Limitations to the studies include staff perceptions which can vary over time; in addition, many hospitals already had implemented methods to improve patient safety. These issues, along with selection bias may have skewed the results of the studies.

Gore, et al., (2010), surveyed all hospital employees involved in operative services in an effort to gauge the perceived level of teamwork, patient safety and error reporting. This was followed by a mandatory 8-hour CRM education seminar sponsored by an independent corporation. The 45 question survey was administered again six months later with mixed results. Nursing personnel perceived a statistically significant ($p < .05$) improvement in teamwork although there was no change among physicians.

This same sentiment held true in a study by Makary et al. (2006); they surveyed operating room personnel in 60 hospitals. Results indicated that surgeons believe that the team is functioning well together while anesthesia and surgical staff do not hold the same beliefs. Furthermore, Elks and Riley (2009) surveyed 200 anesthetists in which 42% of respondents

indicated that anesthetist/surgeon communication was poor and nearly 90% felt it increased stress. Fifty-seven percent believed that good verbal communication between the surgeon and anesthetists led to better patient outcomes and 64% stated they would voluntarily attend a communications course.

A study by Vanderbilt University Medical Center evaluated attitudes toward CRM training after 489 participants underwent an eight-hour training course. Participants responded to end of course critiques and 95% agreed that CRM training would be useful in reducing errors and 80% of respondents stated that CRM would have a dramatic impact in their daily practice (Grogan et al., 2004). The large number of participants gives strength to the study while the anonymous selection of participants could have led to some bias.

These same studies also suggested that hierarchy is a significant barrier to communication. Sexton et al. (2000) found that 55% of surgeons were unlikely to advocate for a flattened hierarchy while 70% of surgical team members agreed that challenging senior team members should be encouraged. The foundation of CRM calls for a flattened hierarchy. Not only are junior team members expected to challenge the Captain, their input should be encouraged by their senior leaders (Musson & Helmreich, 2004). Additionally, Sax et al., (2009) noted that CRM training for healthcare professionals had a definite influence on personal behaviors and empowered employees to create a culture of safety.

Recent evidence presented by McCulloch, Rathbone, and Catchpole (2011) refutes findings from the majority of the above mentioned studies. A systematic literature review led to an in-depth examination of 14 articles based on the principles of CRM. The impetus for the study was to discover scientific evidence that teaching teamwork and communication skills to healthcare workers led to better patient outcomes. Concerns raised by the authors included

training costs of CRM programs, time, and the possibility that communication and teamwork errors have been overestimated in medicine.

McCulloch and colleagues found that multiple issues affected study outcomes. Overestimation of positive results was indicated by a lack of blinding; no double blind studies were performed. Outcome data reporting was poor; standard deviations and the number of group participants were absent in some studies. Also, non-validated scales were utilized in many of the studies. Findings concerning improved communication after CRM training were deemed to be diluted by the possibility of the Hawthorne effect, and improved staff attitudes were attributed to response bias. Additionally, post-training questionnaires were not validated, leading to possible skewed results.

Overall, the analysis by McCulloch and colleagues found that team training might have some benefit in terms of communication and cooperation in the short term, but subsequent training modules are need to establish long term effect. Perhaps the most significant conclusion was that there was no evidence of improved clinical outcomes after CRM training programs (2011).

Although the validity of CRM may seem to be in doubt, the latest data from a Veterans Health Administration (VHA) study provides a direct correlation between the implementation CRM training and a dramatic increase in patient safety. This may finally be the smoking gun evidence that demonstrates the effectiveness of CRM training.

The VHA retrospective cohort study showed a dramatic decrease in surgical mortality, an increase in communication, and improved operating room teamwork after the implementation of team training programs utilizing the CRM theory from aviation. The study represented 108 facilities and over 182,000 procedures between 2006 and 2008. The goal of the study was to

compare VHA facilities that received the training to those that did not, and evaluate the differences in surgical mortality. Seventy four VHA facilities received two months of planning support, a one day conference and one year follow up and support, including quarterly telephone conferences (Neily et al., 2010).

Requirements of the study included mandatory briefings and debriefings designed to improve communication and ultimately patient safety during surgery. Operations included patients receiving general, spinal or epidural anesthesia. Results showed a 50% greater decrease in surgical mortality for trained versus non-trained facilities while trained facilities demonstrated an 18% decrease in mortality from baseline compared to a 7% decrease for not-trained facilities. Confidence intervals were 95% (Neily et al., 2010).

Important findings in the VHA study were a 47% increase in communication among OR staff in 35 facilities, 46% improvement in staff awareness, and overall teamwork improved by nearly 65%. Operating room efficiency also improved in 66% of the trained facilities. Follow-up support and interviews were found to be extremely valuable to the trained facilities as surgical mortality continued to decrease the longer the training programs were in place (Neily et al., 2010).

Limitations to the study were identified by the authors. Facilities that were first trained with the team training model were most likely to show improvement; this might have skewed the results. Propensity score matching was utilized to reduce some of the bias by using baseline characteristics. Additionally, all of the information collected was based on self reporting by facilities and no audits were performed. Another limitation cited was that the population of patients at the VHA medical centers may not typify the patients in the private sector and thus skew the results of the study. Despite the limitations of the VHA study, the conclusion remains

that surgical mortality was reduced substantially by those facilities that participated and were trained using crew resource management theory as adopted from aviation (Neily et al., 2010).

A study performed at Northwestern Memorial Hospital also found that programs in team training can reduce communication errors in the operating room. In an observational period of 150 hours in the operating room, errors were reduced from 56 to 20 after team members took part in a team training curriculum (Halverson et al., 2010). This study supports the notion that team training can improve communication skills among operating room staff.

Impact of CRM Training in Healthcare Education

It is evident that CRM does have some validity in both CRM and in healthcare but the impact that it might have during medical education is unknown at this time. Davies (2005) states that the curricula found in nursing and medical education are lacking any content. The basics of human error, human factors and interpersonal dynamics need to be implemented into curricula and introduced to students from day one along with the joint training of medical and nursing students.

The European Society of Anesthesiologists (ESA) echoes the sentiments by Davies to begin team training early on at the undergraduate level and follow up during postgraduate education. "In order to promote a change in attitudes toward greater patient safety, informing and educating to this end should begin for future doctors, nurses and other health professionals, and for administrators, as part of their training" (Staender, 2010, p.47).

The ESA has laid out a specific postgraduate training course which covers important topics such as root cause analysis, incident reporting, value of simulation, human factors and limitations, teamwork and CRM. The undergraduate training proposal includes the study of

safety culture, the role of teams, stress, fatigue decision making, fixation errors and open communication (Staender, 2010).

Interestingly, team training has been one of the hallmarks of training for at least half of all business schools in the United States, but not an objective for medical students. Medical school education has remained relatively unchanged for the past century since first designed by Abraham Flexner in 1910. Flexner's plan laid out the medical model of two years of basic sciences followed by two years of clinical experience. Physicians were taught to be autonomous, work independently and be rewarded for their achievements. A century later, a model based on teamwork and cooperation is lacking and needs to be implemented into the curricula of all health disciplines (Manasse, 2009; Morrison, Goldfarb, & Lanken, 2010).

As described in the theoretical framework, Tuckman's fourth stage of development is where teams begin to trust each member of the group and function together as a team. Presently in schools of nursing and medicine, this fourth stage of development will be unlikely to take place because the curriculum is not set up to allow for team learning. A primary reason is that faculty themselves do not have the expertise to implement the type of team training that is necessary to create high performance teams (Morrison et al., 2010). One organization that can help to facilitate this education is Teams Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS).

TeamSTEPPS is an organization that was created in 2006 by a joint effort with the Department of Defense and the Agency for Healthcare Research and Quality (AHRQ). The aim is to improve communication and teamwork skills of healthcare professionals. Five team resource training centers exist that offer training to hospitals that prove readiness to undertake the TeamSTEPPS initiative. Readiness involves ensuring that the hospital is prepared and

agreeable to effect a cultural change through teamwork, checklists, support from hospital leaders and the willingness of staff to attend training classes.

TeamSTEPPS has been utilized by more than 14,000 healthcare organizations across the United States and this initiative could be adapted to include medical and nursing students in an effort to teach teamwork during the primary years of education (Clancy, 2009). Two schools, Emory University School of Medicine and Woodruff School of Nursing, have used this training initiative and require the training for third year medical and fourth year nursing students (Morrison et al., 2010).

The Quality and Safety Education for Nurses (QSEN) project is another healthcare initiative that could very well be the catalyst for CRM training as part of nursing education. Founded by the Robert Wood Johnson Foundation in 2005, QSEN aims to improve the safety and quality of training by preparing future nurses to meet the challenges of the evolving healthcare system. The QSEN project uses the six competencies set forth by the IOM to give nurses the knowledge, skills and attitudes to provide safe, compassionate patient care. The competencies include patient centered care, teamwork and collaboration, evidence-based practice, quality improvement, safety and informatics.

In 2008, QSEN and the IOM worked together to launch an initiative that seeks to transform the nursing profession through four key recommendations. One key recommendation was that nurses should achieve higher levels of education and training in order to deliver the safest, patient-centered. Recommended competencies include leadership, teamwork and collaboration as well health policy and system improvement. It is clear that the push for teamwork training during educational training is becoming a reality (Thornlow & McGuinn, 2010).

Team training and patient safety curricula in early education are supported and recommended by the Accreditation Council for Graduate Medical Education as well as JCAHO, but limited studies are available to assess the impact of this training. A study in 2006, however, did attempt to assess the impact of a patient safety curriculum for nurses enrolled in bachelor's, master's, and doctoral level programs for all specialties, including nurse anesthesia students. Nurse anesthesia students were provided with a series of three lectures during their second year that focused specifically on safety content related to anesthesia. Additionally, an adverse event model was integrated throughout the second year of the anesthesia curriculum. This model allowed students to report hazardous events or near miss events that occurred during their last nine months of clinical training. Students were able to report these events using a web based program. Prior to the implementation of this curriculum, senior nurse anesthesia students completed a 52 question survey to assess attitudes, skills and knowledge related to general patient safety and safety related specifically to anesthesia. Students completed the same survey again eight months after the curriculum had been delivered (Ardizonne, Enlow, Evanina, Schnall & Currie, 2009).

Results indicate that 27 students completed the pretest survey and 23 completed the post surveys. Overall, mean scores did increase but were not statistically significant and attitude scores from pre to posttest did not change. The results underscore the difficulty which nurse anesthetists have in changing a culture that has been in place for years. The skills and knowledge that were discussed in the series of three lectures, however, did show an increase from pre to posttest, indicating that structured lectures might be of some benefit. The small sample size may have affected statistical significance.

Recommendations from the study include a patient safety educational curriculum prior to clinicians entering the workforce. The authors are revamping the present curriculum so that the lectures series is more interactive instead of merely one way communication. Although the cohort of students represented a small number for statistical analysis, the results suggest that implementing a formal curriculum during the primary years of education may be effective and should be undertaken (Ardizonne et al., 2009).

A concept known as crisis resource management has surfaced in the field of medicine and the principles are taken directly from the aviation field. The idea of resource management for the anesthetist is to utilize all available resources in the operating room to prevent patient injury. Components of resource management for anesthesia involve using cognitive aids or checklists during emergency situations, distributing the workload among team members, using closed loop communication and having a well thought out plan (Gaba, Fish, & Howard, 1994).

A crisis resource management curriculum was presented to academic faculty of four of Harvard University's medical centers in an effort to teach and improve upon the principles of CRM through simulation based scenarios. Post course surveys and one year follow up surveys indicated that participants felt they had improved their CRM skills and that the quality of the training was high. Of particular interest is that the insurance company discounted the malpractice insurance premiums for those staff who attended the training (Blum et al., 2004).

The field of nursing has been identified as having tremendous potential for transforming the healthcare field into a safer, more cost-effective and higher quality system, but changes to the educational system must be made. Graduates need to have the knowledge, skills, and attitudes to function effectively in the clinical setting and these skills can and should be taught during early education (Thornlow & McGuinn, 2010).

Discussion

Interpretation/Outcome

The purpose of the paper was to determine if evidence exists to support the use of CRM during the formal education process for nurse anesthetists. First, a literature review provided a look at the history of CRM and the adaptations that have occurred over the past twenty years. A thorough review of the current literature has answered many questions about CRM and attitudes toward its use in both the aviation and healthcare industries.

The aviation industry has used CRM with success since the late 1970's although much debate exists as to the true measure of its effectiveness. Anecdotal evidence, however, and reactions to CRM by pilots suggest that it is effective in reducing accidents and has changed the culture of the airline industry. Pilots did not immediately embrace the concepts of CRM and many thought it was an attempt to change their personalities. CRM has continued to evolve over the years, is widely utilized by firefighters and police, and is becoming more prevalent in the healthcare arena (Eisen & Savel, 2009).

The success of CRM in the aviation industry is difficult to gauge with any certainty but the literature review indicated that it has reduced accidents by up to 81% (Rivers et al., 2003). Equally, if not more, important are the attitudes toward CRM by pilots and others in the aviation industry. Studies indicated that CRM had an overwhelmingly positive effect upon improving the attitudes toward safety and team concepts.

CRM concepts have made their way into the healthcare arena after their use was advocated by JCAHO and the IOM nearly 12 years ago, but the literature reviewed presented conflicting evidence on the use and success of these team training concepts. The verdict on whether CRM training for healthcare workers has led to better patient outcomes seems to still

rest in the hands of the jury. However, a study by the VHA has made a powerful impact in swinging the vote in favor of CRM. The results of the VHA study revealed a 50% greater decrease in surgical mortality for VHA facilities that took part in the CRM training program and subsequent follow up support (Neily et al., 2010).

Attitudes toward CRM by healthcare workers were also examined. Operating room nurses and anesthetists hold different attitudes regarding how well team members work together when compared to physicians. Surgeons generally feel that the team works well together but this belief is not shared by surgical nurses and nurse anesthetists. Furthermore, surgeons generally feel that communication is not a problem in the operating room but statistically significant differences exist in the beliefs held by operating room nurses and staff (Carney, West, Neily, Mills, & Bagian, 2010).

Much has been discussed regarding the use of CRM in healthcare and aviation, but where does this leave us in terms of nurse anesthesia education? The comprehensive review of the literature revealed very little information regarding the use of CRM training for nurse anesthesia education. A single study with a small (n = 27) number of participants found that attitudes did not change and no statistical significance was found among those that had completed training. The important finding was that a deeply ingrained culture made it difficult for individuals to effect change in a system where hierarchy is established and not truly supportive of individuals.

Implications for Nursing Practice

Crew resource management training has the potential to change the practice of nursing by empowering team members to use assertiveness skill to question something they deem to be unsafe. At the same time, a non-punitive system must be established that focuses on blaming bad systems, not people (Leape, 2009). The reluctance of a nurse or nurse anesthetist to speak up

about safety concerns is more likely to occur if teamwork or collaboration with the physician is deemed to be lacking.

Compounding the problem is the difference in the perception of teamwork by surgeons and nurses. Some surgeons may not buy into the CRM mantra whether or not they believe that a communication problem truly exists. The hierarchical culture that exists in medicine today might be broken down by implementing the concepts of CRM. Lower patient mortality rates result from effective communication as well as improved situational awareness and improved operating room times (Carney et al., 2010).

Implications for Research

Additional studies are necessary to determine the impact of CRM training during nurse anesthesia education. The review of literature found just a single study that examined this important area of study with no significant changes demonstrated by the limited number of participants. Improved research methods and tools to measure changes in behavior and attitude need to be developed to better assess and compare the effectiveness of team training methods (Blum et al., 2004). Given the recommendations by the IOM over the past five years, this is certainly an area in which more research needs to be done.

Implications for Education

The need to integrate team training and CRM concepts into the educational system has been recommended by various government agencies. In an effort to change the culture of medicine and the hierarchy that exists, learning these concepts must be started during the primary years of medical and nursing education. Even then, young clinicians will face great resistance by senior personnel and administrators when attempting to apply this training to the clinical setting.

Numerous curricula can be utilized for CRM training, with each having its distinct advantages and disadvantages. The important point for educators is to realize that no one approach to team training is the correct way to facilitate team training. Crisis resource management for anesthesiology as developed by Gaba and colleagues uses simulation combined with CRM principles and debriefing to elucidate the importance of using all available resources during a crisis situation (Blum et al., 2004). Despite its roots in aviation, CRM training for healthcare need not look to the aviation field for further guidance as these concepts have been developing in medicine for 20 years. Agencies like TeamSTEPPS have been touted as a possible foundation for teamwork type curricula for nursing and medical schools.

Implications for Policy

The IOM has emphasized the need for a curriculum change for nursing programs that strengthens both the quality and safety knowledge of new graduates. The IOM suggests that faculty be equipped with the knowledge, skills and attitudes to ensure graduates have a firm grasp on patient safety concepts. Concepts included in this curriculum should emphasize reducing errors through changing the system or culture as a whole rather than punishing individuals for their actions. Training in education and patient safety is critical to safeguard patients of the future. In order to establish this culture of safety, training must start as early as feasible (Rall, Van Gessel, & Staender, 2011).

Dissemination

A PowerPoint presentation (see Appendix) was presented to the surgical staff at St. Mary's Hospital in Detroit Lakes, MN in August 2011. The one hour presentation and discussion regarding the use of CRM in healthcare and the proposal for implementing this training into anesthesia curriculum was well received. The surgical staff acknowledged that

communication is a barrier that never seems to go away and anything that can work to change this should be implemented. Additionally, this information was presented at the North Dakota Association of Nurse Anesthetists fall conference in Bismarck, North Dakota in October 2011.

Summary/Conclusion

More than 30 years ago, the deadliest accident in aviation history claimed the lives of 583 people. Out of the ashes arose the concept of CRM. Since the inception of CRM in the late 1970's, the aviation industry has successfully used the principles to reduce accidents. Creating a culture that encourages open communication among team members is a cornerstone of the CRM foundation. CRM principles are being used in the hospital setting to effect similar changes with studies indicating the success of CRM (Neily et al, 2010). The impact of CRM for nurse anesthesia education has not been widely studied but support for team training during early medical education has been recommended by JCAHO, IOM and the QSEN initiative. It is clear that this training should begin early on in the student nurse anesthetist's education.

The systematic review of current evidence revealed that attitudes toward CRM training are positive and team members believe that CRM can help create a culture with a flattened hierarchy. As stated by Manasse (2009), CRM is not a tool that can be introduced just one time, but instead needs constant follow up support and review to be effective. Training should not only be a formal educational requirement but a lifelong process.

Studies have shown that even team members who undergo CRM training are only compliant with the safety practices about 60% of the time (France, Leming-Lee, Jackson, Feistritzer, & Higgins, 2008). This underscores the challenge of changing the culture in healthcare and the need to implement the training starting as early as possible during the primary years of education.

The airline industry was plagued with a hierarchical culture in which subordinates were afraid to question the authority of the captain even in the face of a possible critical mistake. Likewise, personnel working in the operating rooms today may be afraid to challenge the actions of another team member that is deemed to be in a position of higher authority, despite the possibility of harm to the patient. CRM changed the airline industry and has had success in healthcare. The time has come for this training to be integrated into formal education. Nurse anesthesia education may be the perfect platform from which to launch this initiative.

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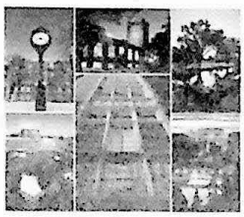
Appendix

Crew Resource Management Training (CRM) for Nurse Anesthesia Education

John P. Lonneman, SRNA

University of North Dakota



UND The University of North Dakota

Why This Topic?

- My background is in aviation...UND Aerospace Graduate and commercial airline pilot for United Airlines.
- Trained in CRM by United Airlines
- Became aware that CRM type concepts were being used in healthcare to improve patient safety & wanted to examine the idea of implementing CRM training for anesthesia education.
- Thought you all have heard enough talks about PONV!

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Objectives

- Define the problem, purpose, significance, and methods used for this project.
- Define and discuss Crew Resource Management (CRM)
- Examine the role of CRM in aviation and in healthcare

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Methods

- Extensive literature review of topic and additional areas of interest utilizing most current research and supporting data.
- Literature Review Included:
  - History of CRM
  - Success of CRM in aviation
  - Attitudes toward CRM in healthcare
  - Evidence of CRM's success in reducing surgical mortality
  - Use of CRM/team training principles in education
  - Recommendations for curriculum for nursing education

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Methods

- Presentation to the Anesthesia Department and operating room staff at St. Mary's Hospital, Detroit Lakes, MN, and CRNAs & SRNAs at NDANA Fall meeting.
- Conceptual Framework: Tuckman's Theory of Group Development.

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Purpose

- To identify evidence that supports implementation of CRM and team training type concepts for nurse anesthesia education.

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Problem

- Significant communication problems continue to plague the current healthcare system.
- The environment in the healthcare setting follows a hierarchy where communication is hindered because team members are not encouraged to speak up or are afraid to challenge a presumed position of superiority (McGreevy et al., 2006).

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Problem

- The IOM has recommended CRM & team training programs as way to consistently achieve patient safety (Clancy, 2009).
- CRM has been a tremendous asset to the aviation industry, reducing accidents by up to 81% (Rivers, Swain & Nixon, 2003).
- In order to effect a cultural change it must start during the primary years of education (Lerner, Magrane & Friedman, 2009; Staender, 2010).

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Significance of the Study

- The loss of lives from preventable medical errors is estimated between 44,000 and 98,000 people every year while the financial impact is estimated to be between $17 billion and $29 billion per year (Kohn, Corrigan & Donaldson, 2011; Rivers, Swain & Nixon, 2003).
- Extrapolated to aviation statistics, this is akin to 200 jumbo jet crashes per year, or a 747 crash every other day (Stahel, 2008).

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Significance of the Study

- American College of Surgeons closed claim study found that communication breakdowns contributed to greater than 85% of adverse outcomes (Stahel, 2008).
- Failures in communication have been identified as the cause of greater than 60% of sentinel events in which 74% of the patients died (Powell & Hill, 2006).
- Communication failures are a leading cause of adverse events during surgery (Awad et al., 2005).

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Crew Resource Management (CRM): What is it?

- The effective use of all resources to achieve safe and efficient outcomes. CRM focuses not on the technical skills and knowledge necessary to accomplish a mission, but instead on interpersonal and team building skills. Elements of CRM include communication and decision making processes, teambuilding, situational awareness, workload management, resource management, avoidance of distractions and prioritization of tasks.
- CRM: pioneered by National Aeronautics and Space Administration (NASA) and joint venture with the airline industry in the late 1970's after series of high profile accidents.
- The most serious accident killed 583 people when two 747's collided on a foggy runway off the NW coast of Africa: Communication failure was listed as a leading cause (Nance, 2008).

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CRM & Healthcare

- In the period from 2001 to 2006 there were zero deaths among major airlines; in that same time period there were an estimated 250,000 to 500,000 deaths in American hospitals from medical mistakes (Nance, 2008).
- The IOM recommended over a decade ago that CRM and team training could be utilized to increase patient safety (France et al., 2005). Still today, patient safety has not improved and communication errors continue to be a leading root cause of sentinel events, adverse outcomes and medication errors (Sexton et al., 2006).

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CRM & Healthcare

- The concepts of CRM have been widely utilized in the healthcare arena and numerous studies have examined attitudes toward CRM, perception of teamwork, communication and hierarchy in the O.R.
- Gore, et al., (2010), surveyed all hospital employees involved in operative services in an effort to gauge the perceived level of teamwork, patient safety and error reporting. Statistically significant improvement among nurses ($p<.05$) but no change among physicians.
- Makary et al. (2006) surveyed operating room personnel in 60 hospitals. Results indicate surgeons believe team is functioning well together 85% of the time, but anesthesia & surgical rated collaboration as high only 48% of the time.
- E&s & Riley (2009) found in a survey of 200 CRNAs that anesthetist/surgeon communication was poor & 90% felt it increased stress.
- Vanderbilt University Study of 489 participants in a CRM course: 95% of participants said training would help to reduce errors while 80% felt it would make a dramatic impact in daily practice (Grogan et al., 2004).

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CRM & Healthcare

- Sexton et al. (2000) found that 70% of O.R. team members felt questioning senior leaders be encouraged while 55% of surgeons did not want a flat hierarchy.
- Sax et al. (2009) – CRM training had influence on personal behaviors and employees were empowered to create a culture of safety.

Differing opinions:

- Hunt & Callaghan (2008) believe that trying to apply the principles of CRM to the surgical setting is too simplistic of a solution citing surgical human factors are different from the cockpit and the leader in the O.R. is not always easy to discern.

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Does CRM Impact Patient Safety?

- McCulloch, Rathbone, & Catchpole (2011): Systematic literature review led to an in-depth examination of 14 articles based on the principles of CRM. The impetus for the study was to find scientific evidence that teaching teamwork and communication skills to healthcare workers led to better patient outcomes.

  Findings: some improvement in communication and cooperation- short term but no evidence of improved clinical outcomes.
- Veterans Health Administration study by Neily et al (2010): Represented 108 facilities and over 182,000 procedures between 2006 and 2008. Compared 74 facilities that were trained in CRM vs 34 facilities that did not receive training.
- Findings: 50% greater decrease in surgical mortality for trained versus non-trained facilities.

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CRM & Anesthesia Education Recommendations:

- Team training should be implemented from day one of nursing & medical school curriculum (Davies, 2005).
- Training in root cause analysis & CRM should occur during undergraduate education & be followed up during postgraduate work (Staender, 2010).
- Quality & Safety Education for Nurses (QSEN) initiative: Founded in 2005. Goal is to provide future nurses with the knowledge & skills to improve patient safety and the current healthcare system. Team training principles are emphasized. Presently in use at 15 colleges throughout the United States.

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Education

- Adrizonne et al. (2009): Study assessed the impact of a patient safety curriculum for nurses enrolled in bachelor's, master's, and doctoral level programs for all specialties, including nurse anesthesia students.
- Small study- 27 students. Results were not statistically significant. Students related that although the training was helpful, the culture in which they worked was still a barrier in making an impact.

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Expert Consultation

Keynote speaker AANA National Convention Boston, MA

"The reality is that hospitals are people, and when, as a team, they can climb free of the failed methods of the past, they indeed can fly, in both spirit and accomplishment."

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Summary

- Limited research on the use of CRM for education- more is needed.
- Literature suggests that CRM reduces surgical mortality & should be implemented into university curricula.
- CRM recommended by JCAHO, IOM and the QSEN initiative.
- A cultural shift is necessary to improve patient safety. This proposed research is important but requires support from the top down. Effecting a cultural shift takes time but can be done.

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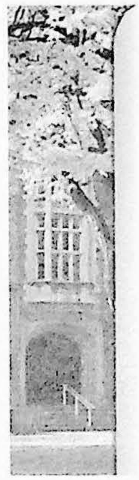

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