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## Trauma in the 21st Century

By Victoria Base-Smith, MSN, CRNA, CCRN, PhD (c)

This article is dedicated to those who lost their sense of security, freedom from fear, and lives in the attacks of September 11, 2001. The attacks and their sequelae depict the scope and urgency of experiences that nurses encounter when treating victims of physical and psychological trauma, often as first responders to a disaster scene. Trauma imposes a destabilizing impact on personal, social, and economic equilibria. During and between moments of great human suffering, nurses make a difference at every transition from triage to recovery.

Whether intentionally provoked by war, terrorism, homicide, sexual assault, or suicide – or unintentionally sustained by accidental poisoning, drowning, motor vehicles, falls, or fire – traumatic injuries have increased with mechanization of the workplace, technological advancement, and sociopolitical turmoil. Proportional to the rising incidence and severity of trauma are the acquisition of an extensive knowledge base and progress towards the multidisciplinary treatment of traumatic injury. The emergence of the medical subspecialty of traumatology signifies the importance of these advances. In

addition, ongoing clinical, academic, and public education efforts are dramatically reducing traumarelated deaths and injuries, giving many people a second chance to live.

Traumatic injury induced by the ravages of military warfare has catalyzed the development and systematization of rescue, surgical, therapeutic, and recovery strategies. Pioneers who confronted the traumatic injuries of soldiers and civilians in conflicts of recent centuries have contributed to facets of traumatic therapeutics that remain useful to this day. Ironically, superiority in weaponry and strategy has not prepared the United States for 21st century warfare. Americans have awakened to the reality of a new type of military conflict – one characterized not only by nuclear and incendiary potential, but by insidious biological and chemical weaponry as well as philosophical attacks borne on the backs of suicide bombers. As nurses, we must educate and ready ourselves for trauma management in the post-September 11th era.

Outside the military realm, the mechanization of work and leisure has led to thousands of employment, transportation, and recreation-related injuries every year. Personal injury during social interactions, whether intentional or accidental, has escalated the incidence of trauma. Changing weather patterns, earthquakes, and oceanographic events, such as El Niño, have provoked natural disasters leading to trauma of country-wide proportions. Man-made disasters stemming from accidents further illuminate the depth and breadth of causation.

To address trauma and its multiple aspects, the Emergency Medical Services Systems Act was created in 1973. Its purpose is to implement and integrate a national trauma management system that embraces not only the treatment of trauma but the development of guide-lines and financing for federal, state, and local prevention programs; preparation of hospitals and municipal- or civilian-response organizations; funding of trauma research and education; and specific guidelines for on-site disaster relief and management.<sup>1,2</sup> Examples of some organizations that support the nation during disasters are the Federal Emergency Management Administration (FEMA), Office of Emergency Management (OEM), Centers for Disease Control (CDC), National Safety and Transportation Board (NSTB), Urban Search and Rescue (USAR), and the American Red Cross.

## Scope of Trauma

Trauma kills more people from 1 to 44 years of age than disease.<sup>3</sup> It causes 43% of deaths in 1- to 4-year-olds, 48% of deaths in 5- to 14-year-olds, and 62% of deaths in 15- to 24-year-olds.<sup>3</sup> Barton<sup>1</sup> attributes 160,000 deaths per year to trauma. Based on tabulation and reporting differences, deaths from intentional or unintentional trauma may be closer to 200,000 annually.<sup>4</sup> And, more than one-third of a million people are permanently disabled by trauma, costing billions of dollars in medical, employment, rehabilitative, and social costs.<sup>1,2</sup>

## Triage and In-the-field Care

The tasks of first responders are: rapid assessment, resuscitation, stabilization, and transportation of the injured.<sup>2</sup> Teamwork and communication is required to limit injury to oneself and support the safety of other rescuers.

Upon arrival to the emergency scene, health-care workers become acutely aware of the major causes of traumatic injury: blunt, penetrating, thermal, and explosive force. Less visible and infrequent sources, such as ionizing radiation (Chernobyl) and biological contaminants (anthrax), may be added to the list. Very promptly, rescuers "size up the scene" and assess their capability to respond, in terms of personnel and equipment. The proximity of fire, smoke, falling debris, rising water, and live electricity and the potential for exposure to toxic chemicals or infectious agents are assessed. When calling for help, the location and brief details of situation, including "how many" and "how bad", are reported.<sup>5,6</sup>

When triaging multiple casualties, resources are directed toward those who will most benefit: the silent, often critically wounded, unconscious victims instead of the "nearest and noisiest".<sup>5</sup> Triage nurses and other rescue personnel must be "blind to horrific sites, deaf to the cries of the injured, have the wisdom of Solomon, and the patience of Job".<sup>7</sup>

The first responsibility is to extricate the victim. It is assumed that the victim has a c-spine injury, and the first task is to stabilize the neck and spine. If extrication is prolonged, basic or advanced cardiac life support is begun. Once the victim is safe, primary attention focuses on the airway, breathing, and circulation (ABCs). Respiration is supported via jaw thrust, intubation, or ambubag-mask ventilation. Mouth-to-mouth resuscitation may be initiated on children and infants in extremis, although using this technique is a personal decision that may no longer be sanctioned by many rescuers. Evaluation of heart rate and circulatory function (bradycardic, tachycardic, thready pulse, and cool, clammy, or cyanotic extremities) ensues to determine hardness. Bleeding is tamponaded with direct pressure, elevation of the extremity, or tourniquet, if required, to prevent exsanguination and save life. Intravenous cannulation and fluid administration, if available, is begun for medication administration and volume resuscitation. Victims are warmed with blankets to reduce hypothermia, slow coagulopathy, provide comfort, and protect from the environment (rain, falling debris).

About 50% of victims die within moments of traumatic injury.<sup>8</sup> Of them, 55% die from head injury, e.g., a severe disruption of brain tissue, brain stem, or upper spinal cord that leads to cessation of respiration.<sup>6,8</sup> The second cause of death is laceration of the heart, liver, or major blood vessels, such as the aorta, carotids, or vena cava.

For the fatally wounded, nursing care focuses on the spiritual and physical comfort of the dying. As their lives draw to a fearful close, nurses in the field hold them, pray with them, and receive their last words. It is a privilege to serve in such a circumstance.

Whenever possible, the injured are identified. They are 'tagged' with critical information, such as name, allergies, medications, pregnancy, and comorbidities (e.g., diabetes, coronary artery disease, seizure disorders). These data are provided by writing

information on adhesive tape, applied to the person's clothing, or directly on the victim's clothes. The tags relay pertinent information to hospital personnel.

Transport to hospitals and first-aid sites occurs via ambulances, helicopters, cars, stretchers, wheelbarrows, wagons, and even piggyback rides. It cannot be overstressed that rescuers must maintain c-spine immobilization and the ABCs to minimize the likelihood of permanent neurologic injury and morbidity.

## Hospital Care

### Emergency room

Eighty percent of admissions to the emergency room for trauma are non-urgent. Ten to fifteen percent are urgent but not immediately life threatening. Severe, life-threatening injuries comprise 5% of admissions. Half of severely injured victims die within the first one to two hours due to neurologic or pulmonary impairment, splenic rupture, orthopaedic, or multi-organ injury with hemorrhage.<sup>1,2,7,8</sup> Exsanguinating, eviscerated, or open head-injured patients are admitted directly to surgery.

Victims resuscitated within 60 to 90 minutes at a level 1 trauma center have a significantly greater chance of surviving and returning to their activities of daily living.<sup>1,7,8</sup> A level 1 trauma center has medical air evacuation and around-the-clock, expert support services in every specialty, 365 days per year.

Nurses stabilize patients who arrive with less life-threatening injuries for further evaluation. Patients are given oxygen via cannula or mask, then connected to diagnostic monitors. ECG rhythm, oxygen saturation via pulse oximetry, and blood pressure are observed continually. The airway, breathing, circulation (ABCs), and neurologic function are evaluated with the Glasgow Coma Scale (GCS). C-spine immobility is retained until the patient is "cleared" by the radiologist and neurologist, indicating that the neck is stable and that the brace or collar can be removed. Patients are auscultated for breath sounds and examined for other injuries, such as bullet entry site, stab wounds, flail chest, pneumothorax, cardiac tamponade, or tracheal deviation.

Many victims arrive with an endotracheal tube, oxygen mask, or other airway device in position, especially when injured by burns, gunshot wounds, or injuries to the head and torso. Prepackaged devices can secure endotracheal and tracheostomy tubes, with Velcro closures, especially when little time for application or surface area for adhesive tape exists.

Emergency room (ER) nurses will cannulate peripheral veins with a large-bore (14- to 18-gauge) intravenous (IV) catheter, if possible and necessary. The Dale bendable ArmBoard™ with adjustable straps may be used to immobilize the forearm for IV and arterial-catheter insertion as well as protect the site in combative patients. When superficial extremity veins are flat due to hypovolemia, the ER physician will cannulate femoral, internal jugular, or subclavian vessels.



Intravenous resuscitation with crystalloids, such as normal saline or lactated ringers solution, or blood transfusion is a life-saving task. Type O- trauma blood is reserved for hemorrhaging women of child-bearing age and women who are pregnant. Type O+ (universal donor) trauma blood is given to victims when typed or cross-matched blood is unavailable or waiting will hasten death by exsanguination.

The donning of gloves, protective eye wear, and often masks is essential during trauma care. Trauma victims are more likely to have HIV, hepatitis, or other diseases.<sup>1</sup> The nurse must coordinate and acquire laboratory samples, orchestrate patient transport, and monitor the timely retrieval of results. Laboratory tests are obtained to assess blood type and cross-match, beta human chorionic gonadotropin (pregnancy), electrolytes, coagulation studies, drug toxicities and levels, hematocrit and hemoglobin, and arterial blood gases. Often tetanus toxoid injections will be administered for injuries involving metal and organic debris. To determine volume and circulatory status, the nurse may insert a Foley catheter, unless prohibited by urological trauma. A Velcro leg holder, such as those supplied by Dale Medical Products, can secure the catheter without the hassle of adhesive tape.

X-ray confirms the diagnosis of bone fractures. Computed axial tomography (CAT or CT scan) provides more detailed imagery of soft-tissue injury than x-ray findings. Arteriography is used for blunt or penetrating trauma to the chest, abdomen, and peripheral arteries to evaluate the presence of dissections and hematomas. Invasive diagnostic peritoneal lavage (DPL), although less often used, can identify intraabdominal bleeding that necessitates emergency laparotomy. Non-invasive sonography is the preferred method in many cases. Other non-invasive studies, such as Doppler, echographic, and ventilation/perfusion (V/Q) scans, corroborate presumptive diagnoses and govern therapeutic interventions.

Emergency nurses are responsible for acquiring personal information from trauma victims. The emergency record is a legal document, therefore data recording is crucial, particularly in homicide or assault cases. This flow sheet informs and directs subsequent care of services after the patient's transfer to another unit. His or her name, age, next of kin, allergies, pre-existing medical conditions, medications, mechanism of injury, transfusion preferences, living will or power of attorney status, presence of implants, and

organ-donation wishes are key elements of the document. Rescue personnel or family members may provide some of this information to the nurse.

## Operating room

### Anesthesia

The anesthetist, whether nurse or physician, will provide the "4 As" of anesthesia: aeration (oxygen), analgesia (pain relief), amnesia (loss of memory), and akinesia (lack of movement). Concomitant anesthetic goals are to support cardiopulmonary, neurological, and organ function; preserve body heat; replace fluids; and correct metabolic imbalances. After monitors (e.g., ECG, pulse oximeter, blood-pressure cuff, arterial line, end tidal CO<sub>2</sub> (ETCO<sub>2</sub>)) are satisfactorily functional and the patient's IVs are patent, anesthesia begins. Aseptic scrubbing and draping ensues, followed by surgical incision and operative repair. A moribund patient - near death - may receive only oxygen and a paralyzing muscle relaxant for anesthesia. When the patient recovers hemodynamic stability, narcotics, benzodiazepines, and anesthetic gases will be administered to supplement the anesthetic.

### Nursing care

At level 1 trauma centers, operating-room (OR) nurses are alerted to the arrival of victims by emergency-room or air-rescue staff. Reports from the trauma scene guide the preparation of equipment and surgical instrument needs. Patients often have multiple system injuries, and surgeons from different specialties will work together on the same patient. Another crucial responsibility of the OR staff is to obtain blood products (e.g., packed cells, fresh frozen plasma, cryoprecipitate, and platelets) from the blood bank, which are then stored in a refrigerator or temperature-controlled cooler within a short distance of the OR for immediate access.

Aside from the crucial activity of orchestrating myriad instruments with the surgeon ("scrubbing"), OR nurses must anticipate trends and organize intraoperative activities ("circulating"). Of great importance is the accurate documentation of intraoperative events. The trauma suite is a very noisy, chaotic, and high-tension environment! Instrument counts, medication inventories, and certification of blood products are a portion of the circulating nurse's responsibility. He or she monitors the sterile technique to prevent operative field contamination, while simultaneously adjusting equipment settings and function on grounding devices, lasers, coagulating/dessicating "Bovies", or suction cannisters; relaying laboratory and pathology reports; and communicating with families. These nonsurgical responsibilities contribute significantly to positive prognoses for traumatized patients.

Hypothermia is detrimental to trauma patients. Keeping the patient warm is everyone's responsibility, even if the room temperature makes the staff uncomfortable. Hypothermia, defined as a body temperature <96.8°F (36°C) may cause coagulopathies, cardiac arrhythmias, and immunocompromise. Trauma rooms must be heated to 80°F or above to

transmit ambient heat to the patient. IV fluids and blood products are warmed (40-41°C) before administration, as are anesthetic gases. Whenever possible, warm air-flow blankets are placed on the patient's body to reduce heat loss via convection, radiation, and evaporative or conductive mechanisms.

### ***Intensive care unit***

Patient mobilization, expeditious removal of tubes, adequate nutrition, and acute rehabilitation are the goals of intensive care.<sup>7</sup> Each stage is dynamic and depends on the patient's diagnosis and response to interventions. Often, death occurs in the intensive care unit (ICU) days to weeks after the initial traumatic injury, secondary to sepsis and multi-organ failure.

Nurses vigilantly observe for signs and symptoms of organ dysfunction, as it arises from coagulopathy, infection, and systemic inflammatory response syndrome. Respiratory function, sustained by mechanical ventilation via endotracheal tube or tracheostomy, is managed with continual observation of pulmonary pressures, sputum production, blood gases, chest tube drainage, and pulmonary toilet. A-lines, ECG, pulse oximetry, Swan-Ganz cardiac and Camino intracranial pressure catheters are continually monitored to determine cardiopulmonary and neurological homeostasis. Feeding and nasogastric drainage tubes are checked for patency and function. Securement of gastrostomy and jejunostomy tubes or Jackson-Pratt type drains can be managed with the drainage bulb holder (Dale Medical Products), which replaces tape or safety pins, to prevent their dislodgement.

Blood products and fluids are given according to specific needs, as discerned by coagulation studies (Pt/Inr/Ptt; CBC; Fibrinogen; D-dimer), cardiopulmonary pressures (wedge, cardiac output), and hemodynamic status. Nurses manipulate various intravenous sympathomimetic infusions to tightly regulate blood pressure, heart rate, renal perfusion (urine output), and intra-cardiac pressures. Infusions of mannitol may be used to control cerebral edema. Muscle relaxants provide akinesia to augment pulmonary compliance and reduce metabolic expenditure. Propofol, morphine, and fentanyl infusions provide analgesia.

Nurses assume that patients can hear and perceive their environment while in an unconscious state after trauma or when in a drug-induced coma. Comfortingly they communicate with patients, telling them the date and time, what they are doing, who has been to visit, etc.

### ***Tube removal***

As organ function returns to normal, drainage tubes will be removed. Satisfactory blood gas levels and spontaneous, adequate, unassisted ventilation leads to tracheal extubation. Adequate urine output and satisfactory hemodynamic function supports removal of urethral drainage catheters. Revival of peristalsis, flatus, and bowel function heralds the removal of nasogastric tubes. Cardiac, multiple lumen, and arterial catheters may be

withdrawn when hemodynamic mechanics are acceptable and sustained without sympathomimetic augmentation (dopamine, Dobutrex®, Neo-Synephrine®, nitroglycerine, Nipride®, etc.)

Other ICU nursing interventions include wound management, laboratory drafts, provision of hygiene, maintenance of skin integrity, and range-of-motion exercises. Additional activities include documentation, preceptorship of health-care personnel, interfacing with support services, and family communication and education.

### ***Nutrition***

A formal nutritional assessment evaluates visceral protein, somatic protein, and fat reserves. It ascertains gastrointestinal function, daily caloric and protein requirements, body mass index, and the specific needs of particular injuries.

Nutrition is provided parenterally or enterally. Total parenteral nutrition (TPN) is administered via a central line when patients cannot consume substrates enterally and when long-term therapy is required. Peripheral parenteral nutrition (PPN) is used when supplementation is required for less than 10 days.<sup>6</sup>

Enteral diets for administration via feeding tubes include<sup>6</sup>:

- intact protein + lactose free
- intact protein + lactose free + high density
- blended + meat-based
- elemental pure amino acids
- polypeptides, and
- formulated for hepatic, pancreatic, pulmonary, or renal organ failure

Management of nutritional infusions via central lines or peripheral administration catheters, monitoring the infection potential of indwelling catheters, and maintenance of dressings are the responsibility of the ICU nurse. The composition of solutions, therapy orders, tapering, and weaning of parenteral nutrition are decided by the nutritionist and attending physician. Electrolyte and blood glucose levels must be carefully noted by all care providers to prevent hypo- or hyperglycemia.

### ***Convalescence***

Convalescence begins when the patient is relocated to a medical or surgical ward. In that milieu, the patient gradually returns to fundamental activities of daily living (ADLs). Feeding, bathing, walking, bowel and bladder function, and recovery of circadian sleep patterns are among the major tasks of convalescence. Some catheters, IVs, tubes, and devices may remain in situ, so the attending nurse will still need to manage and observe them. Nursing assistants or family members may help the patient with ADLs, thus forging an opportunity for patient and family education about medications, treatments, and rehabilitation. After satisfactory recuperation, the patient will be discharged to home

or a rehabilitation facility. Often, a follow-up visit by a home health nurse is arranged to assess problems of adjustment or recovery.

## Rehabilitation

### *Psychological*

Of paramount concern in a traumatized patient is the development of psychological conditions, which may or may not manifest in hospital. Reactions to traumatic experiences tend to be short-lived, but prolonged or excessive maladaptation to trauma requires psychiatric rehabilitation.<sup>19</sup> Post-traumatic sequelae may arise from problems existing before trauma, may be related to the effects of trauma, or may follow stressful medical, surgical, or rehabilitative procedures.<sup>9</sup>

Pre-existing psychological problems may stem from alcohol and substance abuse. Anxiety disorders, affective illnesses, and lack of adjustment may emerge when cognitive function normalizes.<sup>9</sup>

Psychological disturbances attributable to trauma include<sup>2</sup>:

- survival guilt
- phobic avoidance (isolation, withdrawal)
- bereavement
- loss of future plans; loss of limbs; loss of function
- sleep problems
- hypervigilance
- dissociation

Some post-traumatic stress is related to the surgical or ICU experience. Sleep deprivation, terror from the pain of procedures, drug effects, inability to communicate (secondary to paralysis while on ventilator), and disorientation are responsible. Other sources are worries about child care, financial crises, adverse physical and social outcomes, and generalized uncertainty.

No specific treatment exists for psychological trauma.<sup>9</sup> Careful diagnosis and treatment of coexisting psychiatric disorders are major focuses of attention.<sup>9</sup> Patient and family education enhances recovery. Education should begin in the emergency room with explanations about procedures and outcomes.<sup>9</sup>

More intensive therapies use desensitization techniques and, if necessary, hospitalization to treat severe psychological symptoms. Counseling and group therapy with specialists in post-traumatic stress management is helpful.

Mental health-care workers at disaster sites assist people suffering from acute traumatic stress by implementing critical event debriefing. Rescuers, survivors, and witnesses of traumatic events need someone to listen to their stories. Debriefing teams identify people

at risk and offer help. Debriefers listen and reassure people that they are responding normally to tragedy. A primary goal is to inform the victims about delayed feelings that may arise days or weeks after the disaster. Follow-up meetings are encouraged to assess the victim's level of distress.

While in hospital, patients may experience intrusive thoughts, fear of returning to work, and fear of people.<sup>9</sup> They may perceive themselves as cowardly or weak. Survival guilt may haunt some patients.

Critical event debriefing minimizes the development of post-traumatic stress disorders. Being made aware of particular psychological response mechanisms and symptoms may enable patients to seek help before maladjustment arises.

### ***Home care and physical rehabilitation***

Rehabilitation is a restorative process that helps patients to regain independence and reintegrate the biopsychosocial, vocational, physical, and mental functions that existed prior to traumatic injury.<sup>10</sup> Rehabilitation services in America emerged after World Wars I and II,<sup>10</sup> when more than 5,000 amputees and over 265,000 soldiers who had sustained combat injuries returned home. To meet their needs, the U.S. government, together with volunteer agencies, promulgated rehabilitation services for disabled veterans. Consequently, rehabilitation services for civilians soon emerged.<sup>10</sup>

Rehabilitation services are multidisciplinary, not only involving medical diagnosis and nursing care but social services, counseling, pharmacy, nutrition, speech, physical, and vocational therapists.<sup>11</sup> Financial and legal advisors, equipment suppliers, and, most importantly, the patient's family are integral parts of this multifaceted team.

Physical rehabilitation begins in hospital. Based on the patient's records, the home-care nurse evaluates the patient's current level of self-care and needs, then plans and implements an effective strategy for physical and psychological rehabilitation. This effort is coordinated with all members of the multidisciplinary team.

Severely burned or spinal cord-injured patients require very intensive rehabilitation in centers specifically designed for such an activity. Other appropriate settings for rehabilitation are in hospital, within long-term nursing-care facilities, outpatient centers, and at home.

Waters, Sie, and Adkins<sup>11</sup> define the home activities to which general rehabilitation is directed. They are activities of mobility (from bed to wheelchair, toilet, and car); ambulation (with or without assistance); and self-care (grooming, feeding, toilet care, dressing, and bathing). Specialized tasks may be directed toward the recovery of vision or adaptation to blindness, communication (speech or use of speaking tools), and the maintenance of cognitive integrity.

Teaching and skill development are integral to developing responsibility for self-care of tracheostomies, medications, stomal feedings, and prostheses. Reducing stress to alleviate anxiety and dyspnea as well as the frustration of having a dependent or disabled role must be addressed.

Clemen-Stone et al<sup>10</sup> state that rehabilitative care begins with the involvement of the patient's family and health-care provider, then moves toward the patient's assumption of maximal self-management. These goals are achieved through communication between team members, the revision of plans, when necessary, and the use of special resources (medical equipment suppliers, religious counselors, social services, etc.).

Rehabilitation can be a long process for the traumatically injured person. It affects the patient, family, health-care providers, the economy, and society. From a pragmatic perspective, resources for proper rehabilitation are shrinking. In today's restrictive economic climate, many people are not receiving ideal rehabilitative care, equipment, or interventions. Furthermore, people of all ages need recuperative care - from premature neonates, at home for the first time, to senior citizens of fragile and impoverished means, who can no longer live independently. In these situations, some rehabilitative nurses may become frustrated, but most find great satisfaction and enjoy numerous small victories, when brainstorming over rehabilitation dilemmas.

Dedication to patient care, despite mounting difficulties, evokes new strategies and creative alternatives. Nurses still have a calling - reinforced with expert skills, the gift of curing, and the care to make a difference.

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## Objectives

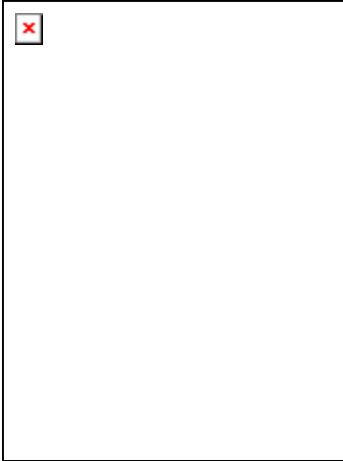
After reading this article, the learner should be able to:

1. Describe social and political factors that have led to the evolution of trauma therapy and affect its incidence.
2. Define the scope of trauma.
3. Describe crucial interventions for the rescue of traumatized victims.
4. Identify goals for nursing care of the traumatized patient in the ER, OR, and ICU.
5. Define strategies for psychological and physical rehabilitation before and after hospital discharge.

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## Biographical note

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**Victoria Base-Smith, MSN, CRNA, CCRN**, was recently nominated for the Florence Nightingale award. She is a member of the AANA, AACN, Sigma Theta Tau, and MENSA. She has completed nursing doctoral coursework and is currently pursuing a doctorate in psychology. Ms. Base-Smith plans to specialize in post-traumatic stress disorder. She has volunteered at the Door of Hope in Johannesburg, South Africa and at Ground Zero in NYC. She has traveled extensively. Ms. Base-Smith, who has published in various journals and anesthesia texts, enjoys the clinical teaching of nurse anesthesia students and caring for Veterans.