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Eraritjaritjaka revisited: The future of trauma and acute care surgery a symposium of the 2018 North Pacific Surgical Association Annual Meeting

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Eraritjaritjaka (Timothy Bax, MD, Spokane, WA)

Eraritjaritjaka is derived from the language of the Aranda people of central Australia meaning 'a yearning for something that has been lost'. In 2000, Lancet published an essay by the Belgian physician Joris Nauwelaers where he lamented several changes in medical education and practice that had occurred in the prior two decades.[1] He lamented the perceived loss of dedicated teachers in medical schools and the loss of skilled instruction in the value of a well performed history and physical examination rather than reliance of algorithms and advanced imaging. He lamented the loss of generalists over specialists and subspecialists. He wrote, "A century ago doctors could do little more than observe and comfort. Yet they were highly respected, could work without interference or criticism, let alone litigation, and were well paid, although surgery, antibiotic therapy, and effective drugs were all virtually non-existent. In short, they were appreciated for doing almost nothing. It was self-evident then that only a doctor could be head of a hospital. And where are we now? Yes - suffering from Eraritjaritjaka! Nowadays everybody interferes with medicine. There have

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always been Eskimoes who would tell the Congolese what to do when the weather is too hot. Despite their ignorance, a host of people claiming some paramedical competence hamper the tasks of medical men. Insurance companies are launching arbitrary regulations and restrictions on doctors with the same goals as commercial and money handling parties and they are now quite at home in medical institutions because that is where the money is. As a result, politicians, while invoking the paying of so-called third parties, have assumed the right to decide on the most complex medical matters." He concluded, "We urgently need to review medical teaching, restore doctors to their right place, and throw commerce and ignorance out of our temples. If we do not, I believe that general medicine, physical diagnosis, and efficient and cheap medical care, will have to be found, and to be learned, in central Africa, which may be the only place left where we, for the time being, could get rid of that awful feeling of Eraritjaritjaka."

In 2006 the Journal of the American College of Surgeons published an editorial authored by several prominent trauma surgeons entitled 'Acute Care Surgery: Eraritjaritjaka'.[2] The theme of lamenting changes in trauma surgery was similar to that of Nauwelaers' essay. The authors lamented the near extinction of the general surgeon able to operate comfortably throughout the neck, chest, abdomen, pelvis, and extremities. To this they attributed the expansion of surgical subspecialties limiting the experience of general surgeons to perform lung resections, pancreas surgery, liver resections, arterial repairs and fracture management. They noted that trauma surgery had become mostly nonoperative for a variety of reasons including the decline in penetrating trauma prevalence at trauma centers and the mandates of the American College of Surgeons Committee on Trauma to pull surgeons out of the operating room and into the emergency department to care for and admit patients traditionally cared for by orthopaedic and neurologic surgeons. Two potential solutions were identified:

1. Deemphasizing the role of surgeons in trauma. This meant having other specialties such as critical care, medical hospitalists and neurologists care for trauma patients.
2. The European model of expanding the role of the trauma surgeon to include interventional radiologic procedures, orthopedics, neurosurgery and vascular surgery, both electively and emergent.

They concluded, "As representatives of the generation of trauma surgeons who were fortunate to have experienced the golden age, we submit that the key ingredient to salvage our discipline is the return to performing complex surgical procedures. We have Eraritjaritjaka."

Another decade has passed and it is thus timely to ask, "Where are we now? Do we still have Eraritjaritjaka?" At the 105th Annual Meeting of the North Pacific Surgical Association (NPSA), we convened a panel of academic, community, and military trauma and acute care surgeons including an international trauma surgeon from the Philippines to review this question. Four lectures outlining challenges and opportunities that Trauma and Acute Care Surgeons currently face were given; a strong proposal by Ernest E. Moore, MD, the Editor in Chief of the Journal of Trauma & Acute Care Surgery, for us to return to our roots of operative surgery; a review of the current development of a trauma system in the Philippines by Joel Macalino, MD, the Chair of the Philippine College of Surgeons Committee on Trauma; a presentation on the challenges and opportunities that the generation of aging but invaluable 'open surgery era' surgeons are facing by Frederick A. Moore, MD of the University of Florida; and a review of the current state and future of military trauma surgery by Col Matthew Martin, MD, of Madigan Army Medical Center. A panel discussion with surgeon participation from the membership of the NPSA was then convened. The NPSA is a blended organisation of academic and community surgeons from the United States and Canada. This essay is a synopsis of the panelists' presentations and the open discussion that followed.

Challenges and opportunities for Trauma and Acute Care Surgery in the Ivory Tower (Ernest E Moore, MD, Denver, CO)

The discipline of Trauma and Acute Care Surgery (TACS) was established in urban safety net hospitals in the mid-1970s as a result of the development of trauma centers. TACS evolved naturally from prevailing practice as trauma surgeons were obligated to provide 24/7 hospital coverage and, thus, were the surgeons immediately available for surgical emergencies. Moreover, due to the prevalence of gunshot wounds (GSW) in these environments, trauma surgeons became capable of operating in the neck, chest, abdomen, pelvis, and extremities including all vascular injuries. While known as trauma surgeons, these surgeons maintained a robust elective operative schedule and were frequently requested for complex non-trauma elective operations due to their recognized expertise in a broad range of surgical skills. The demise of the academic trauma surgeon began in the late 1980s due to a combination of factors, and I believe we have not avoided extinction yet.

Perhaps most conspicuous was the advent of computed tomography (CT) scanning, replacing diagnostic peritoneal lavage as the key diagnostic adjunct to determine the need for exploratory laparotomy. Over the ensuing decade rapid adoption of CT scanning led progressively to the nonoperative management of the overwhelming majority of solid organ injuries. The operative experience was further reduced in many urban settings as the volume of GSWs was decreased with the focus on controlling gang wars related to drug trafficking. But in the 1990s a combination of less obvious factors profoundly compromised the operative domain of the academic trauma surgeon. The proliferation of surgical specialties, promoted by their respective fellowships, continued to erode elective surgery opportunities. Arguably the most devastating was the separation of vascular surgery from general surgery. The decline in elective surgery was further exacerbated by the increased time commitment of trauma surgeons to surgical critical care. In 1995 The Journal of Trauma became the Journal of Trauma: Injury, Infections, and Critical Care. Finally, the over-designation of trauma centers, due to the American College of Surgeons Committee on Trauma focus on trauma centers rather than trauma systems, further diluted the trauma experience at major academic trauma centers. Collectively, trauma surgery was threatened as a recognized surgical specialty.

In 2004, the American Association for the Surgery of Trauma (AAST) developed an ad hoc committee to address the options: 1) eliminate trauma as a recognized specialty of general surgery, 2) allow trauma surgery to suffer a progressive decline to extinction, or 3) restructure trauma surgery as a viable specialty.[3] Ultimately, after extensive committee discussions, town hall meetings, and deliberations by the AAST leadership, we agreed to rename our discipline Acute Care Surgery: Trauma, Critical Care, and Emergency Surgery. While attractive, the problem was the practice of emergency general surgery varied enormously across the US. Consequently, some of us felt we should highlight our unique capabilities and commitment to trauma and, thus, the name 'Trauma and Acute Care Surgery' to distinguish ourselves from the emerging discipline of Surgical Hospitalists.

A systematic review of the University Health Consortium surgery database in 2015 documented the 10 most frequent operations performed by academic Acute Care Surgeons: placement of nontunneled catheters, wound care, debridement of muscle/fascia,

insertion of chest tube, tracheostomy, insertion of arterial line, laparoscopic cholecystectomy, placement of gastrostomy tube, closed treatment of rib fractures, and laparoscopic appendectomy.[4] Consequently, we had evolved from TACS to SONOWTD; i.e., service for operations no one wants to do (or could be done by a PGY2 surgical resident). To further compound the decline in interest for TACS, academic centers implemented the shift concept to accommodate restrictions in resident work hours. Patients now are managed by a 'team' of surgeons and residents who change throughout the day. Nurses complain they do not know who to call for management issues and families are confused of who is in charge.

The solution is to develop a surgical discipline to perform operations no one else can do.[5] Most of us became surgeons because we thrive on operative challenges and the associated pathophysiology. We have tremendous opportunities in minimally invasive thoracic and abdominal procedures and, most specifically, in endovascular and open vascular procedures. One recent national survey indicated that a disappointing <40% of popliteal injuries are managed by trauma surgeons at level 1 centers.[6] Many of the new generation of fast track vascular surgeons do not have the training or interest to perform open vascular reconstruction for acute injuries. This need is further accentuated by the relative lack of vascular training in general surgery programs.[7] A potential solution is for the next generation of trauma surgeons to acquire endovascular skills as well as open vascular techniques. This new focus would necessitate a year of dedicated vascular surgery training, which could be an option for the second year of an Acute Care Surgery fellowship. This would, of course, require cooperation by academic vascular surgeons and interventional radiology. In the larger picture, the diversity of the practice of emergency and elective surgery among TACS in academic centers may be better addressed by pursuing board certification in Trauma Surgery rather than Acute Care Surgery.

The creation of the Philippines' regional trauma centers and (possibly) a national trauma system (Joel Macalino, MD, LLB, Manila, Philippines)

It was almost 20 years ago, while I was a Fellow in Surgical Critical Care at the Oregon Health & Science University (OHSU), that I started yearning to help build a national trauma system in the Philippines. Back then, after my daily duty of checking up with my patients, I was asked by Dr. Donald Trunkey to observe the process and proceedings as the OHSU would undergo visitation for reaccreditation of their trauma center.

Until about 3 years ago, the Philippine Trauma System existed in only four areas; surrounding Philippine General Hospital (PGH) in Manila, at the Subic Bay area in Central Luzon (the former home of the United States Seventh Fleet), the Cebu City area (administered by the Emergency Response Unit Foundation) and at Davao City (administered by the Davao 911) (Fig. 1). As an archipelago, the physical separation of the different provinces and regions may have posed a hindrance to the development of a trauma system, but all the essential and important aspects of trauma care are already in place. We have a healthy collaboration between the Philippine College of Surgeons through its Committee on Trauma, (PCS-COT) the Philippine Society for the Surgery of Trauma (PSST), the University of the Philippines/PGH Department of Surgery/Division on Trauma (PGH Trauma), and the Department of Health (DOH).

The impetus was the availability of funds

Three years ago, Republic Act 1035 or the Sin Tax Reform Law was passed by Congress. Essentially, it is a 'health measure with revenue implications'. The idea is very simple, 'sin' commodities like alcohol and cigarettes will be heavily taxed and the revenues will help finance the Universal Health Care program of the Government.

As the money is being generated, the difficult task of planning the National Program was placed under the stewardship of the Health Facilities Development Bureau of the DOH. It seemed to be a simple task after the 'formula' was made - establish or develop related medical centers that would address the leading causes of mortality in the Philippines.

Developing the plans for a Regional Trauma Centers

Trauma, being the 4th leading cause of mortality was identified to be addressed by the DOH. They requested the Philippine College of Surgeons for resource persons and the PCS assigned its Committee on Trauma to look into this. We looked at two essential documents for the development of The Philippines Regional Trauma Centers. First, the Resources for the Optimal Care of the Injured Patient of the American College of Surgeons wherein the concept of escalating and de-escalating care, transfer and transfer back and leadership in the region were adapted. And from the Essentials of Trauma Care of the World Health Organisation, we adopted the basic 'Needs of the Injured' and essential equipment to manage them.

We established the following inclusion criteria. For a hospital to be considered a DOH designated and a PCS verified hospital, it should comply with the following requirements:

1. A minimum of 600 Trauma admissions per year
2. An accredited General Surgery Program
3. Complement of consultants with the following specialties:

Thoraco-Cardio-Vascular, Orthopedics, Neurosurgery, Pediatric Surgery, Urology and Plastic/Reconstructive Surgery.

4. Trauma training for doctors, surgeons, nurses, EMTs and other personnel.

The Essentials of Trauma Care also has a list of recommended Trainings and Competencies which turned out to be either already being offered in the Philippines or had equivalents. The PCS has the following training and workshops:

A. Advanced Trauma Life Support (ATLS)
B. Basic Evaluation and Training in Trauma and Emergency Response (BETTER) for training of doctors, not surgeons or surgical residents. This workshop has a variant for nurses.
C. Basic Emergency Skills for Trauma (BEST), are being given to Surgical Residents.
D. Surgical Critical Care Workshop

In addition to the above, trauma related trainings and workshops are available in the Philippines and administered by other societies and institutions:

A. Definitive Surgical Trauma Care Course (DSTC) is administered by the PSST together with an industry partner.
B. Pre Hospital Trauma Life Support (PHTLS) is offered by at least three groups, foremost of which are the ERUF and Davao 911.
C. Trauma Training for Nurses (TRAIN), a workshop designed and offered by the PGH.

Other important aspects of this Regional Trauma Centers and system shall be Quality Assurance, Surveillance, Monitoring,

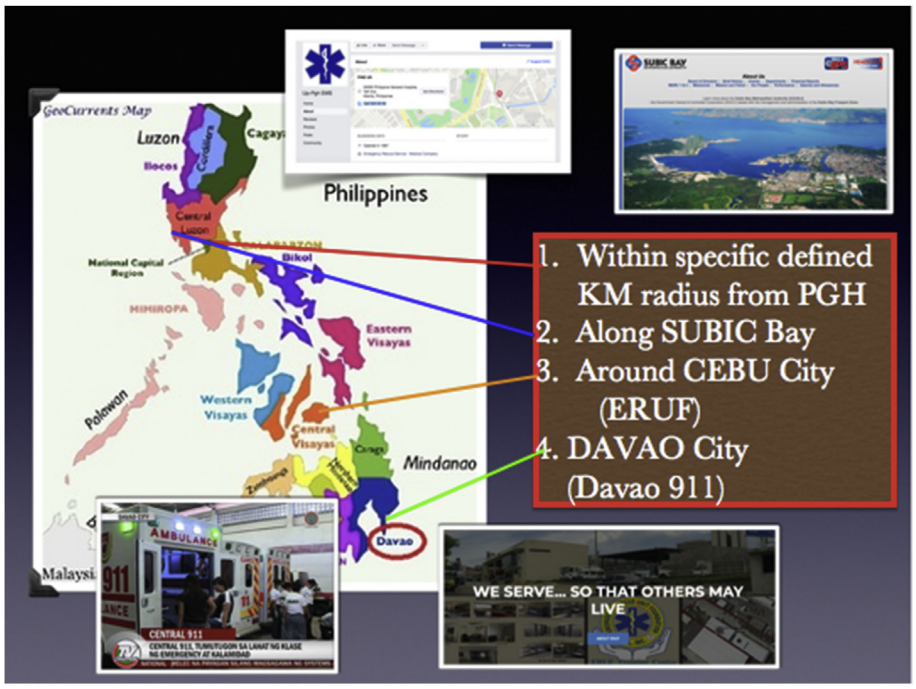

Fig. 1. Limited areas in the Philippines where Trauma Systems exist.

Hospital Inspection for further verification and re-verification. For this, we envision a monthly reporting of the centers, and at least an annual mortality and morbidity and preventable death conference to be participated in by the heads or director of the Trauma Centers. Together with the appropriate monitoring bureau of the DOH, the Philippine College of Surgeons may be the best institution for this.

We should develop even further, the referrals and inter-hospital transfer facilities and protocols. This, in essence will be the requirement that would essentially seal the deal for a National Trauma System for the Philippines connecting this Regional Trauma System with the existing hospitals in the country.

Also, we identified the primordial requirement of **SUSTAINABILITY.** After the development of the Regional Trauma Centers, the initial funding for facilities and equipment, the staffing and additional positions, how can this project be sustainable?

Apex trauma centers

Before these plans could be passed and approved by the Secretary, another echelon of care was envisioned in the designation of an Apex Trauma Center. An Apex Trauma Center was initially envisioned by the DOH as one with the highest service capability for trauma treatment and management to lead all other trauma centers within a geographic area. They are supposed to assist and guide the development of other centers. And for this aspect, we identified the PGH for the Luzon area and would identify 1–2 Apex Trauma Center in the Visayas and another in the Mindanao area.

The good plan

In essence, for the Philippines, we have developed different levels of trauma care. Each level supporting a group of hospitals below it. All hospitals will at least have a **Trauma Unit** in their emergency room to receive majority of the people who sustained minor injuries. Above this are **Trauma Receiving** hospitals, capable of rendering care to people who sustained more serious injuries. Or, they can be transferred to a **Trauma-Capable** hospital of which some will be designated and verified **Trauma Centers**. Above these centers are the **Apex** and subspecialty hospitals.

Subspecialty hospitals are included in the escalating care. They are the Heart, Kidney, Lung Centers and the Philippine Orthopaedic Center. Though at present, they are housed mainly in Metro Manila, there are also plans to develop subspecialty hospitals at least for the three main areas of the country, Luzon, Visayas and Mindanao. The plan adopts the escalation of care, transfer facilities and transfer back facilities. The development or establishment of this system will be funded by the revenues from the 'sin' taxes.

Initially, about twenty-three hospitals applied to be developed as trauma centers. These are all DOH/Government hospitals with accredited training in General Surgery and already have developed expertise in Trauma Management due to the volume of admission of injured patients.

A boost to solve the problem of sustainability

Everything that we had worked for were approved by the DOH and included in the General Appropriations Act for 2018. Further guidelines were developed before the approval of this plan. Most notable under these guidelines are items number 3 and 6. The staffing patterns of the hospital as regards its Trauma Center will be submitted to the Department of Budget Management and that the Philhealth, the Philippines 'Medicare Program' was tasked to develop a 'case rate' packages involving the management of trauma patients. This means that the Trauma Center, even if it is a government hospital, will be 'paid' for their service while the doctors will have some renumeration in taking care of trauma patients.

In the end, a total of 28 hospitals representing all regions of the Philippines, applied to be Trauma Centers. Three hospitals would still have to be verified so that additional funding given to a Trauma Center will be given to them in 2020. They represent all the regions of the country. Nine hospitals were given their budgetary support to further develop as a center; nineteen more are slated to be developed in 2019.

Summary

In 1999, while a fellow of Surgical Critical Care, it was almost by accident that I got to see and experience first-hand, how the Trauma System in the US works. I experienced how it was to be under the tutelage of 'the big man', Donald Trunkey, OHSU Chair of Surgery and foremost advocate of the Trauma System. During this short time in Portland, I nurtured the idea of helping to develop a trauma system in the Philippines. And, after almost 20 years, this is the closest we could get in developing Regional Trauma Centers and a Trauma System in the Philippines.

OMG! I Am the oldest person In my or (Frederick A Moore, MD, Gainesville, FL)

Impact of aging on surgeon competence

Factors that adversely impact surgeon competence include abnormalities in senses (hearing, visual acuity, color discrimination, touch), motor function (manual dexterity, fine motor, stamina), cognition (reaction time, attention, adaptive thinking, three-dimensional thinking, processing speed) and psychology (depression, burnout, addictions).[8] While abnormalities in senses and motor function can be easily tested and recognized by other participants of the operative team, the same is not true for abnormalities in cognition and psychology. Similar to all physicians, surgeons have a disturbingly high rate of psychological problems (including 10% suicidal ideation, 15% excessive alcohol consumption and 20% minor psychiatric disorders).[9] Burnout is particularly problematic among trauma surgeons,[10] but becomes less so in aging surgeons who have learned to control their working lives and develop protective defenses in their patient relationships.[11]

Abnormal cognition, however, is problematic because it inevitably occurs with aging, it is not easily tested or easily recognized by others until it is severe and surgeon self-assessment is poor.[12] In fact, most surgeons believe that they constantly are improving clinical decision making and prefer to ignore the effects of aging. Formal neurocognitive testing does show that the overall decline in cognition in aging physician occurs at a slower rate than the normal population.[12] However, with advancing age deterioration in cognition is increasingly variable.[13,14] While most surgeons will maintain cognition across the multiple domains, the bottom 25% will show considerable deterioration beyond the age of 65 years.[14] Similarly, in the CCRASS study where surgeons performed three computerized cognitive tests (of attention, reaction time and visual learning), ~60% of senior surgeon (≥60 yrs) performed as well younger surgeons (45–59 years) and that no senior surgeon performed below the younger surgeons on all three tasks.[15,16] However, over the age of 70 years, there was notable decline in performance of these tasks. Other aging studies show a progressive decline in adaptive thinking, processing speed, memory, and reaction time. Verbal skills and somatic memory are preserved, while pattern recognition and clinical wisdom may actually increased.[12] Studies of the effects of aging on outcomes after surgery reveals interesting differences. Waljee et al. looked at mortality after eight elective procedures performed in Medicare patients and showed no differences between older (>60 years) versus young (41–50 years) surgeons in 5 elective procedures (aneurysm repair, aortic valve replacement, cystectomy, esophagectomy, lung resection) for low, medium & high-volume surgeons.[17] However, they showed higher mortality for low or medium volume older surgeons performing the remaining three elective cases (carotid endarterectomy, coronary artery bypass and pancreatectomy). On the other hand, a more recent study looking at mortality after emergency surgery in Medicare patients found the opposite effect of surgeon age.[18] The oldest surgeons (60 ≥ years) compared the younger cohorts (<40, 40–49 and 50–59 years old) had the lowest mortality and the lowest mortality with the oldest surgeons occurred in the highest risk patients. Lastly, when looking at newer minimally invasive laparoscopic hernia repairs, older low procedure experience surgeons (<250 cases) versus younger low procedure experience surgeons had a much higher recurrence rate (18% vs 3%) but older high procedure experience surgeons had a low recurrence rate (3%).[19]

In summary, aging causes an inevitable decline in cognition. This decline is quite variable but most aging practicing surgeons are not cognitively impaired. They compensate through increased pattern recognition based on previous experience. However, beyond the age >70 years the lower 25% show significant deterioration in cognition on formal neurocognitive testing. How this relates to poor outcomes after surgery is not clear, but this is concerning because the cognitively impaired surgeon may not recognize this and continue to practice. Additionally, those working with cognitively impaired surgeon may not recognize this or may enable the surgeon in their continued practice.

Mandatory retirement

This debate centers on striking the correct balance between patient safety and liability risk versus loss of a valuable community resource.[20,21] Aging US trauma surgeons (>60 years) represent a unique resource since they are the last generation of maximally invasive trained surgeons who have experience operating on a broad range of surgical emergencies. In the current acute care surgery team model, they represent an invaluable resource to the younger surgeon team members. While some countries (Canada, Ireland, Russia, China and India) mandate retirement at 60 or 65 years, that policy in the US would result in result is a significant loss of the surgeon workforce (~20%).[21] Additionally, the "*Mandatory Retirement and The Age Discrimination in Employment Act of 1967*" outlaws forced retirement based on age, however, the US Congress has set mandatory retirement age for other safety sensitive professions [including commercial airline pilots (65 years), FBI agents (57 years), and air traffic controllers (56 years)].[21] An alternative is to mandate a formal "Comprehensive Evaluation" for surgeon over a set age (e.g. 70 years) to facilitate hospital credentialing and privileging decision. The *"Aging Surgeon Program"* at Sinai Hospital of Baltimore opened in 2014 for this purpose and is a two-day multidisciplinary confidential evaluation of physical & cognitive function.[22,23] Some hospital systems are now requiring this. In response to this debate, the American College of Surgeons issued a "Statement on the Aging Surgeon".[24] In brief summary it states: a) cognitive data does not favor mandatory retirement because of too much variability, b) mandatory retirement will adversely impact on access to care (especially in rural communities), c) recommends physical examination and visual testing starting at age 65 to 70, d) encourages neurocognitive testing using confidential online tools and f) acknowledges that occasionally surgeons will need referral for a comprehensive evaluation.

What can be done to maintain surgeon competence?

Surgeons of all ages should adopt a healthy lifestyle including not smoking, drinking in moderation, routine exercise, minimize sleep deprivation and a healthy diet. The latter is particularly important in aging surgeons. High protein intake (1.5 g/kg/day) is needed to overcome the normal anabolic resistance that characterizes loss of muscle mass with aging sarcopenia.[25] Additionally, to avoid sarcopenic obesity at older ages, the overweight surgeon should adopt a sustainable caloric restriction diet (combined

resistance exercise) to promote slow weight loss while minimizing loss of muscle mass.[25] Surgeons have a high rate for psychologic problems (depression, burnout and addictions) and should seek help early before impacts on their professional performance. Stress management/mindfulness interventions are effective at addressing burnout.[26]

To enhance cognitive capacity, older surgeons should participate in cognitive-stimulating activities including reading nonmedical literature, pursuing educational opportunities and learning new skills/hobbies.[27] It is important to do things that stimulate different parts of the brain. PET brain imaging studies during recall and source memory testing show that high-performing older adults counteracted age-related neural decline through a plastic reorganization of neurocognitive networks.[28] A comprehensive review by Hertzog et al. concluded that cognitive function in older adults can be enhanced by a) structured-training requiring executive coordination of skills (e.g. complex video games with task-switching & divided attention tasks), b) maintaining of an intellectually stimulating environment with an active lifestyle and meaningful social engagement including multi-generational friendships and c) aerobic physical activity.[29] Specifically, they cite a meta-analysis of randomized aerobic-fitness- training studies that report improved cognition in aging study subjects across multiple domains of cognition.[30] It is noted that the largest benefits were observed for executive-control processes (such as planning, working memory and multitasking) and that the positive effect were largest when aerobic training was combined with strength and flexibility training. Finally, it is important to start financial planning as soon as possible to insure the feasibility of retirement if aging disabilities preclude continued practice. It is also important to make a plan for transition to retirement. Unfortunately, most aging surgeons do not have a plan. Their self-identity is heavily based on their professional activities and sudden cessation (i.e. retirement) will lead to dissatisfaction in most.[21] A plan of graduated retirement is more tenable where operating is reduced (i.e. decreased number or complexity of cases), while increasing the time is devoted to administration, teaching and research or to pursing other non-surgical activities.[31]

War of the worlds: the acute care surgery model on the modern battlefield (Col Matthew Martin, MD, Madigan Army Medical Center, WA)

As outlined in previous sections, there have been rapid and drastic changes in all aspects of general surgery residency training, as well as fellowship training in the fields of trauma, critical care, and emergency general surgery.[32,33] Although much of this is often blamed on the imposition of tight work-hour restrictions, this is a multi-factorial problem that includes the shift to minimally invasive surgery techniques, the rise of nonoperative management for trauma and other acute conditions, the increased use of endoscopy and interventional techniques for both procedures and complication management, and the loss of open vascular cases due to the rise of endovascular surgery.[33] Several studies have examined overall case volumes for graduating surgical residents and found them to be stable despite these changes.[34] However, multiple other series have shown alarming trends in the types of cases and experience of graduating residents despite the preserved total case volumes.[35] In addition, there has also been a clear trend toward decreased levels of autonomy allowed to even senior surgical residents. In summary, this has resulted in graduating surgical residents who are less experienced in open surgery, major trauma surgery, and may have little to no experience with open vascular surgery. These same factors have had similar impact upon fellowship training, and the entire specialty of trauma surgery.[36] The marked decrease in the incidence of penetrating trauma over the past two decades coupled with the rise of nonoperative and interventional management strategies has markedly decreased the operative caseload at even the busiest trauma centers. These trends, along with other associated practice pattern-related factors, led the specialty of trauma surgery to embrace and incorporate emergency general surgery under the relatively recent umbrella label of Acute Care Surgery.[37]

These rapid and profound changes in the training experience and paradigm have impacted the military in a similar fashion and degree to our civilian colleagues. However, although the scope and adverse effects on training of these trends are similar between military and civilian training programs, their ultimate degree of importance and urgency are arguably much different. This is due to the differences in the typical career progression and expectations of new surgical residency graduates between these two settings as shown in Table 1, and particularly over the past 15-plus years of continuous combat operations in the Middle East. On the civilian side, most graduates will either go on to fellowship or have a transition to practice where they will have guidance and support from colleagues and senior partners. They will typically practice in a setting where multiple specialists are readily available and able to assist or to take over on challenging problems that are beyond the comfort level of the new graduate. If the new graduate desires to take on a subspecialty case, like a vascular or thoracic procedure, they may face resistance due to 'turf battles' and not due to the complete lack of subspecialty support. And in essentially every setting, if they do not have the ability or support to care for a certain problem at their location, then transfer to a tertiary center can be readily arranged. For the graduating military resident with the current operational tempo, they can expect to be deployed almost immediately after graduation. They will get very little in the way of medical pre-deployment training, as the majority will focus on non-medical soldiering tasks and skills. They will often be in a setting where there is little to no subspecialist support, and no senior partner to provide guidance. In fact, they may be the senior medical provider at that location or may be paired with another new/recent graduate. Most importantly, they will often be called upon to manage an incredibly wide range of surgical pathology, including severe blast injuries, thoracic and vascular trauma, burn injuries, and advanced emergency and elective surgical pathologies in host-nation patients who have no other options for care.[38] For many of these situations, they will have few to no options for transfer and there may be no 'higher level of care' in the local healthcare system that they can transfer to.

Another important aspect of the concerning issues around current training paradigms and limitations that is of particular concern to the military is the exposure and experience of deploying (or deployable) surgeons in a number of separate but related skillsets and specialty areas. These are areas that either do not traditionally fall under the current civilian general surgery training paradigm or that have been significantly de-emphasized in most residency training programs. Although these areas are arguably of less

Table 1
Challenges for the new graduate.

Civilian	Military
Transition to practice	Combat deployment
Fellowship training	Pre-deployment training
Multi-specialty	Uni or Bi-specialty
Senior partners	No partner, or peer-partner only
'Turf battles'	'Giant vacuum'
Hurt pride	Hurt patients
Transfer the problem	You own the problem

importance to preparing the civilian surgeon for their future scope of practice, they remain of critical importance to the military surgeon who will be expected to function in austere operational or combat environments. Table 2 outlines some of these key concerns, and their associated impact. The modern battlefield surgeon must be intimately familiar with burn evaluation and management, and in particular safe and effective burn resuscitation. Penetrating thoracic and abdominal injuries are common in these settings, and the surgeon must be comfortable with open approaches to the chest and abdomen, as well as organ exposure and vascular control for repair or resection. Neurosurgical techniques, including the ability to perform a basic craniotomy or craniectomy, are needed due to the high incidence of severe TBI and the limited access to a Neurosurgeon. One of the hallmarks of complex blast injuries seen in Iraq and Afghanistan has been major genitourinary trauma, and a familiarization with exploration and initial surgical management is critical.[39] Major extremity injuries, including mangled or amputated limbs, are among the most common wounds that will require surgical intervention. All deploying surgeons should have a solid working understanding of extremity amputations and basic fracture management including external fixator placement. Critical and detrimental changes to general surgery training also include the expanded use of advanced practice providers to serve as surgical first assistants, advanced techniques such as endoscopic saphenous vein harvesting and endovascular interventions, and the increasing role of robotic surgery which often relegates the resident to the role of bedside assistant rather than operating surgeon. Finally, the deploying surgeon must have a high level of skill and confidence with ultrasound, as this may be their only available imaging modality. In this respect, General Surgery training and adoption of ultrasound has lagged far behind other specialties such as Emergency Medicine.

A final critical aspect of deployment preparation and readiness for the new graduate or junior surgeon is related to the numerous challenges and potential pitfalls related to serving in these types of environments. These are scenarios or issues that can frequently arise, but that we rarely discuss or incorporate into residency or pre-deployment training programs.[40] Table 3 lists some of these common issues, divided into four main areas of interpersonal, adaptability, leadership, and ethical/moral. The new deploying surgeon needs to be able to rapidly and effectively integrate themselves into a usually small and close-knit team as the 'new doc', and to build trust and cohesion. They also need to be able to work with patients and colleagues from widely disparate cultures and backgrounds, and particularly need to effectively work with local host-nation medical personnel. They must be adaptable and able to take on challenging cases that may be outside of their usual training and experience; and know how to seek help and input. Of particular importance, the surgeon must understand both their designated role and their actual role as a leader. Whether they are in a formal leadership position or not they will be seen as a key leader in all clinical activities and must wield this 'soft power' appropriately and effectively. There may be significant conflicts that can arise between authority of rank versus clinical authority, particularly if a non-clinician leader is giving an order that may adversely impact patient care. There are also challenges that relate to both leadership and interpersonal skills if the surgeon is tasked with leading others who may outrank them or is being led by someone who is junior to them in rank and/or experience. Finally, the austere combat environment is a rich breeding ground for ethical and moral conflicts. These most commonly related to conflicts between the medical rules of engagement (MROE), which dictate local policies for who is eligible for care and what level of care, and medical ethics or morals.[41,42] The surgeon must also be prepared to have to make difficult decisions related to truly limited resources. This may include terminating resuscitation due to limited blood supply, providing care to detainees or prisoners, practicing a different standard of care for local nationals versus U.S. or coalition patients, and the role/utility of performing elective or 'humanitarian' cases.[43–45]

All of the above issues and challenges confronting the military related to the training and readiness of the battlefield general surgeon are not new. However, they are becoming increasingly problematic due to the multiple converging factors affecting residency training, trauma volume and practice, and the increasingly disparate critical skillsets between civilian and military surgeons. Overcoming or mitigating these factors will require a systematic approach to clearly identify and prioritizing existing gaps or deficits, developing effective intervention programs, and accurately measuring their efficacy and cost-effectiveness. Table 4 contains only a partial listing of some current programs that have been implemented to address these issues, and potential future initiatives. Among the most important over-arching principles that will be key to a successful overhaul of the military training paradigm is getting out the current 'just in time training' mentality. This is characterized by a focus on brief high-intensity courses or training programs that a deploying surgeon attends immediately prior to departure, which often fall far short of ensuring deployment readiness, and which lack any standardization or universal attendance requirements.[46] This system has served as a critical stop-gap measure but should be replaced by a universal and comprehensive maintenance of competency/certification program. This would rely on universally required and continuously tracked metrics that ensure that all deployable military surgeons have routine exposure to trauma care (in either military or civilian trauma centers), adequate operative volumes and complexity, complete trauma-related continuous medical education credits, and have all required training and certifications (ATLS, ATOM, ASSET, BEST, etc) prior to deployment. In the spirit of the title of this session, 'Erar-itjaritjaka Revisited', we must realize that simply 'longing for something that is lost' is not going to offer a solution to the challenges facing Acute Care Surgery and the military trauma surgeon.

Table 2
Changes in training rotations, techniques, and operative paradigms impacting readiness for military deployment.

Eliminated or de-emphasized	
Rotation/Factor	Critical skills lost
Burns	burn depth assessment, resuscitation, airway, escharotomy, skin grafting
CT Surgery	opening/closing chest, saphenous vein harvest and prep, cardiac/aortic exposures and repair, vasopressor management
Transplant	open abdominal exposures and vascular control, vascular and biliary anastomoses
Neurosurgery	brain injury management, craniotomy, craniectomy, ICP monitor/drain placement
Urology	genitourinary trauma assessment, scrotal exploration, kidney/bladder repair and resection techniques
Orthopedics	amputation/mangled extremity management, external fixator placement, tendon repair, fasciotomy
Operative paradigm changes	
Use of APPs	decreased opportunities to first-assist on major cases
Techniques	endoscopic vein harvest, endovascular, advanced laparoscopy
Robotics	resident relegated to bedside assist

Table 3
Additional challenges commonly faced by deployed military surgeons.

Interpersonal	integrating into a small and often close-knit team as the "new doc"
	building team cohesion and trust, and dealing with any dysfunction
	cultural competency in providing care to host-nationals
	working with host-nation medical personnel and building trust
Adaptability	working with limited or inadequate supplies, equipment
	operating in all areas of the body and doing unfamiliar procedures
	adapting surgical decision making based on local assets/standards
	finding creative solutions and workarounds for major limitations
Leadership	assuming the role of a clinical leader in the unit and wielding "soft power"
	understanding and working in the local chain of command
	balancing the authority of rank versus clinical authority for patient care
	leading people who may be senior to you in rank and/or experience
	being led by someone who may be junior to you in rank/experience
Ethical/Moral	thoroughly knowing/understanding the "MROE" – local policies/practices
	dealing with situations where MROE conflicts with ethics/morals
	practicing with two (or more) standards of care by patient populations
	making hard ethical decisions related to truly limited resources/capabilities
	challenges performing elective or "humanitarian" surgery in a combat zone

Table 4
Listing of select current and in-development or suggested future programs for readiness of deployable surgeons and surgical teams.

Current/Existing Programs
1. MHSSPACS – strategic partnership between Military Health System and the American College of Surgeons
2. Programs bringing senior civilian surgeons (trauma, vascular) to military medical centers providing care for combat-wounded service members
3. Emergency War Surgery and Extremity War Surgery pre-deployment courses
4. Military modules/add-ons for ATLS, ATOM/ASSET, BEST courses
5. Military trauma training programs at civilian Level 1 trauma centers
6. Cooperative training agreements and/or off-duty employment approval for military physicians to take trauma call and civilian trauma centers
7. Multiple deployment-specific textbooks and multimedia resources now available
In Development & Future Programs
1. KSA Project – identifying critical knowledge, skills, and attributes for all deployable military specialties, and metrics for assessment, testing, and tracking
2. Establishment of a continuous maintenance of certification/competency program for the battlefield surgeon
3. Creation of multiple embedded military teams and training programs at high-volume civilian trauma centers
4. Establishment of training rotation programs outside of the U.S. in foreign trauma centers with high volumes of complex and penetrating trauma cases
5. Training opportunities with rural surgical practices in the U.S. that may more closely reflect the austere and low-resource deployed environment
6. Uniform and universally required pre-deployment training courses
7. Development of realistic and valid simulation training programs (video, manikin, perfused cadaver, etc.) for critical combat surgery skills

The days of high volumes of complex open trauma, emergency, and vascular surgery cases in the US are gone, and are not coming back. We must move forward with creative, well-thought out, and evidence-based approaches to carefully and deliberately make up for these shortfalls of modern general surgery training and practice, and as they apply to the requirements of battlefield surgery.

Proposals & statements

Acute Care Surgery Fellowships should be restructured to have a greater exposure to operative surgery including adequate exposure to complex elective and emergency general surgery cases.

The diversity of the practice of emergency and elective surgery among TACS in academic centers may be better addressed by pursuing board certification in Trauma Surgery rather than Acute Care Surgery.

General surgery and TACS fellowship programs should incorporate international 'austere environment' and high-volume penetrating trauma center rotations.

Military surgery training programs should also seek to maximize exposure to critical subspecialty evaluation and management skills, including vascular surgery, thoracic surgery, urology, neurosurgery, and orthopedics. This should be augmented with both didactics and high-yield/high-fidelity simulation, cadaver, and live-tissue training.

Trauma and Acute Care Surgeons should seek to expand their procedural capabilities, e.g. laparoscopic common bile duct exploration, surgical stabilization of rib fractures, additional thoracic trauma procedures such as video assisted thorascopic (VAT) evacuation of retained hemothorax, complex ventral hernia repairs, diaphragm pacing for high cervical spinal cord injuries, anterior spine exposures, complex diverticulitis surgery with associated follow-up procedures, and interventional radiologic procedures.

Regionalization of TACS (including the incorporation of surgeons that would alternate emergency surgery call in both urban and rural settings) should be encouraged.

Senior surgeons need to recognize their changing capabilities as they age and accommodate their lifestyle and surgical practice to preserve their mental and physical health.

Junior surgeons should take advantage of the 'open surgery' experience of their senior colleagues nearing retirement by including and accommodating the aging surgeon's changing capabilities into their practice.

Junior Trauma and Acute Care Surgeons should avoid the trap of becoming a trauma surgeon who only takes trauma call and covers the intensive care unit. New graduates need to operate frequently in their first few years to mature in both technical skill and decision making.

Conflicts of interest

The authors report no conflicts of interest related to the content of this article.

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