Session 7

20th and 21st Century Regional Conflicts

Military Medicine

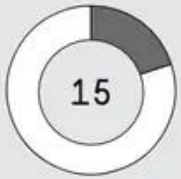
"If war is the dark side of humanity, then military medicine is the light."

Dr. Jonathan Woodson, 2013

CURRENT UNITED STATES COUNTERTERROR WAR LOCATIONS

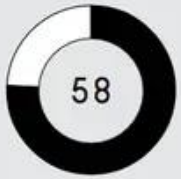
NUMBER OF **76** TOTAL AFFECTED COUNTRIES ENGAGED THROUGH...

Air & drone strikes

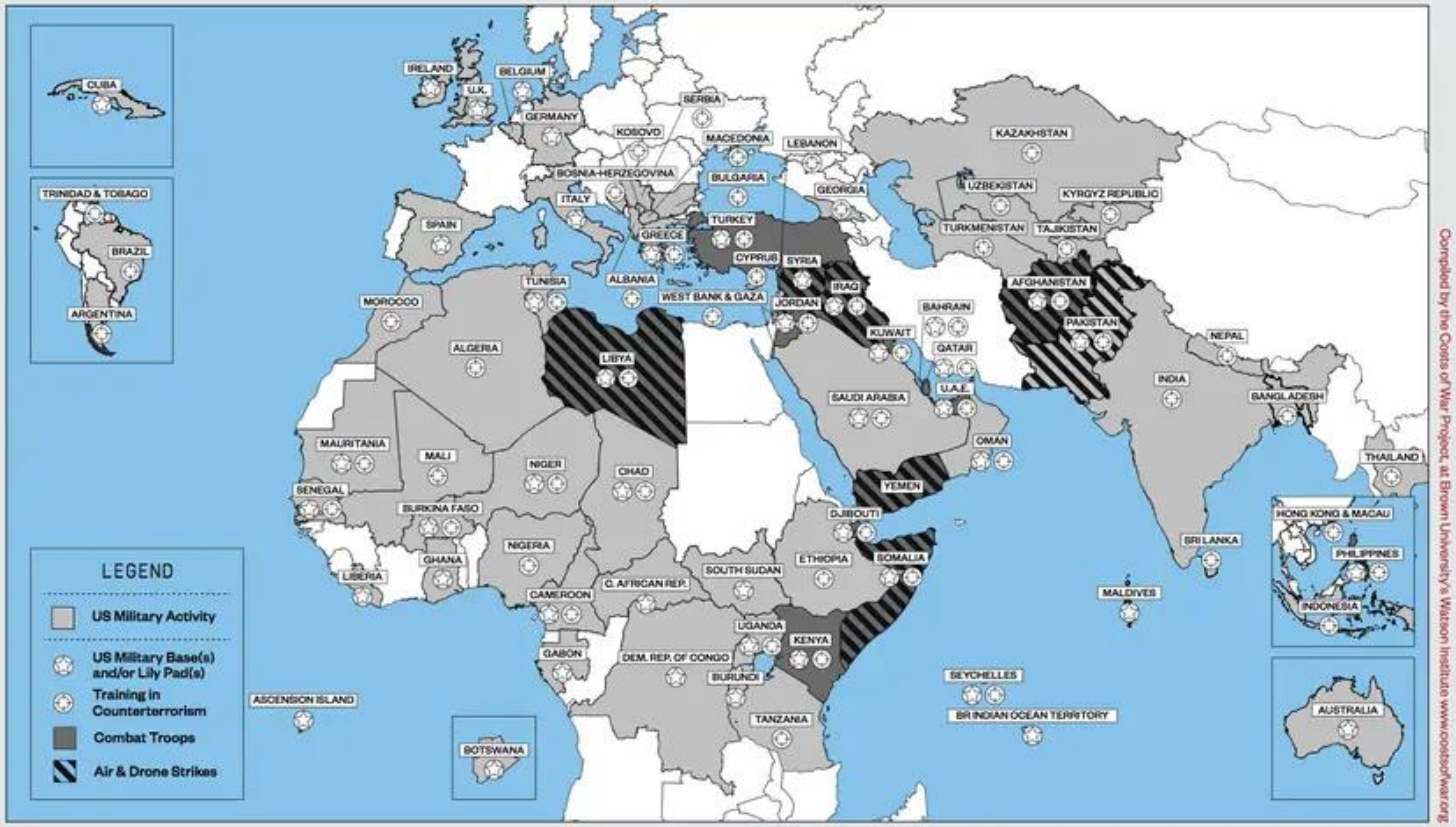


Combat troops

US Military bases



Training in counterterrorism



Compiled by the Costs of War Project, at Brown University's Watson Institute www.costsofwar.org

THE US COUNTER-TERROR WAR INVOLVES **39%** OF THE WORLD'S COUNTRIES

DEFINITIONS

US Military Activity includes one or more of the following:

- **US Military Bases:** Country hosts one or more US military bases, lily pads, or contingency locations used in counterterror activity.
- **Training in Counterterrorism:** The US military gives training and/or assistance to this country's security forces to combat terrorism.
- **Combat Troops:** Country hosts US service members who take direct action on the ground against terrorism, either in this country or in a neighboring country.
- **Air & Drone Strikes:** The US operates direct air and drone strikes in this country.

* **Current:** US military activity documented between 2015 – October 2017

Post 9/11 Conflicts

- Conflicts in support of DoD activities:
  - Gulf War (Iraq, free Kuiwait)
  - Operation Enduring Freedom (Afghanistan),
  - Operation Iraq Freedom (Iraq)
  - Operation New Dawn (late phase of Iraq Freedom)
  - Operation Inherent Resolve (Iraq and Syria, against ISIS)
  - Operation Freedom's Sentinel (late phase of Enduring Freedom)

GULF WAR
1990-1991

Gulf War
1990-1991

- Armed campaign waged by a 35-country military coalition in response to the Iraqi invasion of Kuwait.

- Spearheaded by the US, it was carried out in two key phases
  - Operation Desert Shield: military buildup from August 1990 to January 1991
  - Operation Desert Storm: began with the air bombing against Iraq on 17 January 1991 and ended with the American-led Liberation of Kuwait on 28 February 1991.

Gulf War Syndrome

- Many returning coalition soldiers reported post-war illnesses, known as Gulf War syndrome (GWS) or Gulf War illness (GWI).
- Common symptoms reported are chronic fatigue, fibromyalgia, cognitive problems, insomnia, rashes, and diarrhea.
- Researchers found that infants born to male veterans of the 1991 war had higher rates of two types of heart valve defects.
- Some children born to GW veterans after the war, had a kidney defect not found in GW veterans' children born before the war.

Gulf War Syndrome

- Exposure to pesticides and to *pyridostigmine bromide* (prophylactic pills against nerve agents) has been linked with the neurological effects seen in GWS.

- Other possible causes are *sarin*, *cyclosarin*, and oil-well fire emissions, but their relationship to the illness isn't clear.

- Researchers have said that they don't have enough information to link birth defects with toxic exposure.

- Studies consistently indicate that GWS is not the result of combat or other stressors and that Gulf War veterans have **lower** rates of PTSD than veterans of other wars.

Gulf War Syndrome

- It is unknown why certain veterans showed, and still show, medically unexplained symptoms while others did not.

- Also, why symptoms are diverse in some and specific in others, and why combat exposure is not consistently linked to presence or absence of symptoms.

- The lack of measurement and monitoring of the substances to which veterans were exposed make it difficult, or often impossible, to reconstruct what happened to them during their deployments 20 years after the fact.

IRAQ WAR
2003-2011

Iraq War
2003-2011

- Armed conflict that began with the invasion of Iraq by a US-led coalition to overthrow Saddam Hussein.
- The conflict became an insurgency opposing the coalition forces and the new Iraq government.
- US troops were officially withdrawn in 2011.
- US became re-involved in 2014 heading a new coalition, but the insurgency and much armed conflict are ongoing.

Iraq War

Casualties

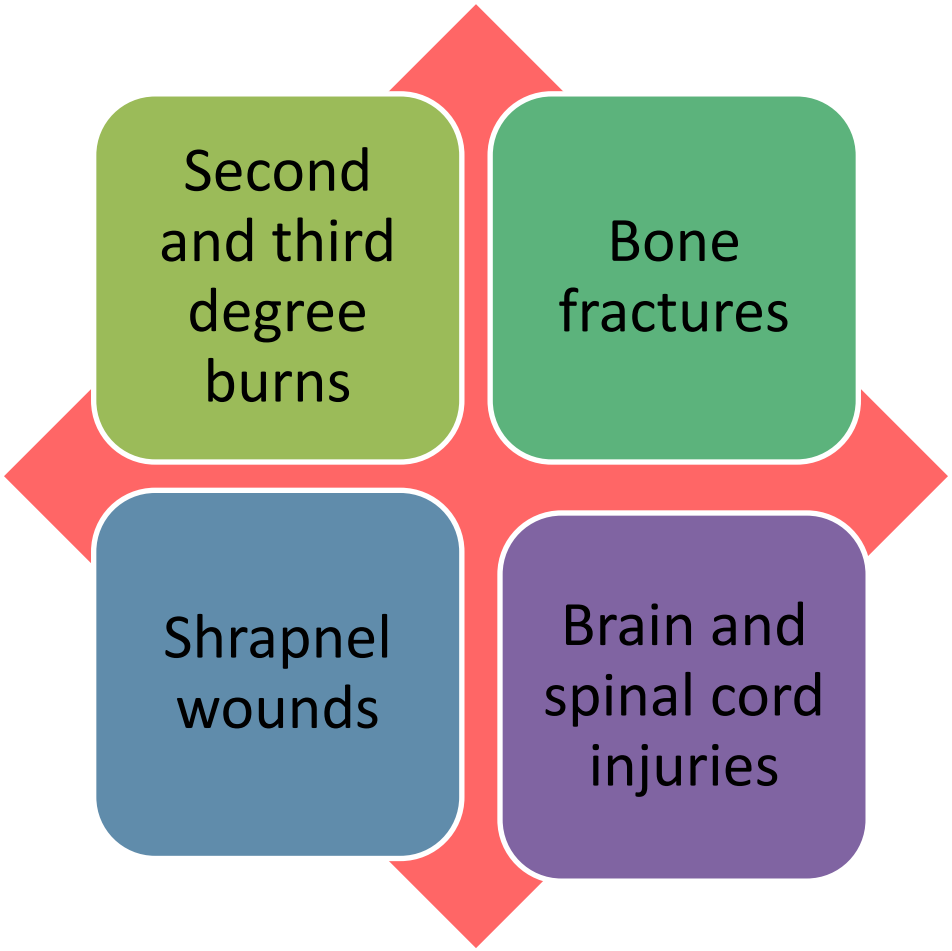
- The figures given on the official Department of Defense (DoD) casualty website include only those “wounded in action.”
- Not included are those suffering from “non-hostile injuries” and other medical problems arising in theater, such as heat stroke, suicide attempts, respiratory problems, and vehicle crashes.
- Other problems are not diagnosed and are not fully recognized until the injured return home: toxic exposure from dust and burn pits, resulting respiratory, cardiac, and neurological disease.
- Military mental health providers use PTSD diagnoses to help returning soldiers receive assistance with a variety of problems when reintegrating into their families and communities.

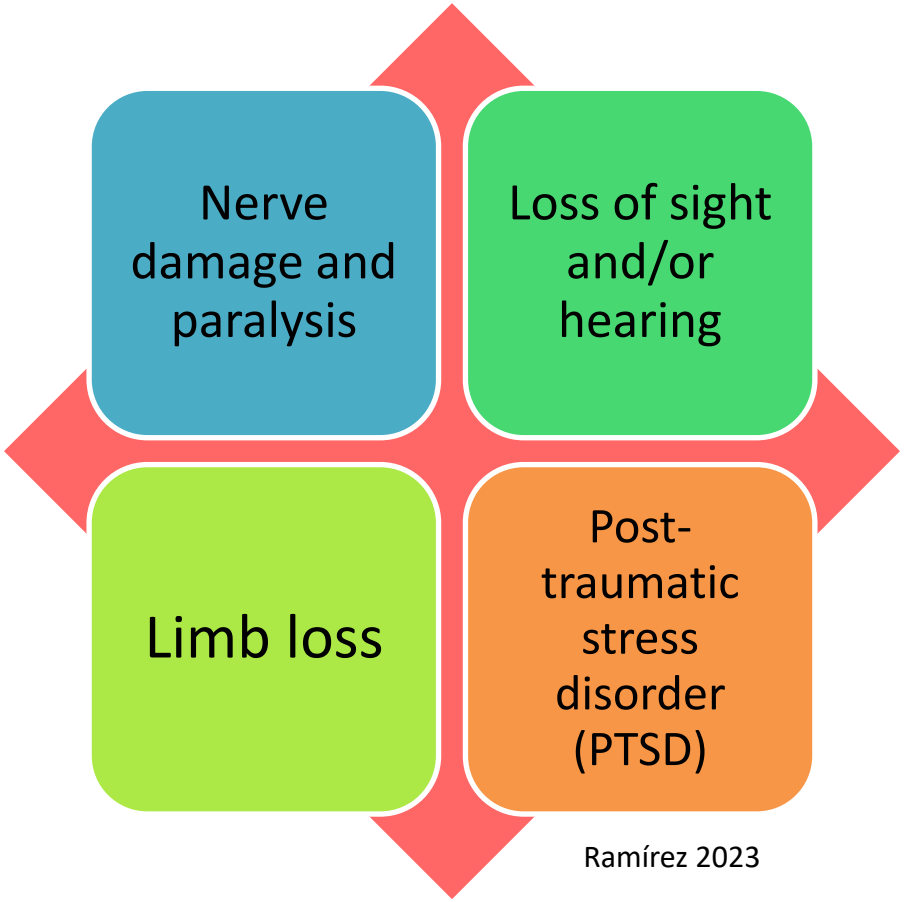
Iraq War

Casualties

- DoD only reports a small fraction of those hurt in the combat zones: those wounded in action.
- More injuries and illnesses have been publicly recognized post-combat than in theater.
- Pentagon contractor injuries, especially of non-U.S. citizen employees, are underreported.

Common Combat Injuries





Ramírez 2023

Iraq War

Military Medicine Issues

- Surgeons saw startling rates of pulmonary embolism and deep venous thrombosis, maybe because of the severity of the extremity injuries and reliance on long-distance transport.

- Initial data show that 5 percent of the wounded at Walter Reed had a pulmonary embolism, resulting in two deaths.

- Using anticoagulants in patients with fresh wounds and in need of multiple procedures would seem unwise.

- There was no facility or expertise in Iraq for the routine placement of inferior vena cava filters.

Iraq War

Military Medicine Issues

- By 1990, the weight of the equipment for a MASH unit was more than 200 K pounds, so the hospital was mobile in name only.

- Armies in the Persian Gulf War (1990–1991) moved rapidly, and MASH hospitals were unable to keep up with the rapidly advancing front.

- MASH units were too cumbersome to support armored units racing into Kuwait and Iraq, so a new organizational structure was needed.

Iraq War

Military Medicine Issues

- A 20-person Forward Surgical Team (FST) was created to provide resuscitative surgery close to the front lines.
- The role of the fixed-base hospital was taken by a Combat Support Hospital (CSH), a modular unit capable of supporting between 44 and 248 beds.
- The reorganization was completed in 2003 when the 212th MASH became the 212th CSH in Iraq.

Iraq War

Military Medicine Issues

- Physicians deployed to Iraq carry weapons, wear body armor, and are constantly under attack; moreover, they often must perform in desert conditions of heat, sand, and dust.

- Patient care must continue in the face of daily power outages, explosions, and the need to duck into bunkers to avoid incoming artillery and insurgent fire.

- In spite of these challenges, many combat hospitals achieved a 98% survival rate, highest ever recorded.

Iraq War

Military Medicine Issues

Trauma care for US soldiers in Afghanistan and Iraq was provided through five levels of care:

- **Level I,** “buddy care” and front-line first aid
- **Level II**, Forward Surgical Team (FST)
- **Level III**, CSH, which is similar to civilian trauma centers
- **Level IV**, surgical hospitals outside the combat zone, such as Landstuhl Regional Medical Center, Germany
- **Level V,** CONUS major US military hospitals like Walter Reed in Washington DC, or the National Naval Hospital in Bethesda, MD

Iraq War

Military Medicine Issues

- There is a limited number of medical personnel available in a voluntary force to support the 130 K to 150 K troops fighting in Iraq.
- The Army had only 120 general surgeons on active duty and a similar number in the reserves, so it tried to keep no more than 30 to 50 general surgeons and 10 to 15 orthopedic surgeons in Iraq.
- Most have served in FST's with 20 people: 3 general surgeons, 1 orthopedic surgeon, 2 nurse anesthetists, 3 nurses, plus medics and other support personnel.
- In Vietnam, only 2.6 percent of the wounded soldiers who arrived at a surgical field hospital died, which meant that most deaths occurred before the injured made it to surgical care.

Iraq War

Military Medicine Issues

- At the front line, every squad had a combat lifesaver with resuscitation training, and each soldier had a tourniquet.
- If surgical resuscitation was required, the patient was immediately moved to a higher level of care.
- Level III Army hospitals are large (248 beds), with surgical specialists, laboratories, radiology, and blood banks.
- Definitive surgical treatment can be provided at a Level IV hospital but may be provided at Level V, where limb salvage and reconstructive surgery are performed.

Iraq War
Military Medicine Issues

- All amputees begin rehabilitation at a Level V hospital.

- Burn patients are sent exclusively to Brooke Army Medical Center (San Antonio, TX).

- C-17 transports, known as the “flying ICU’s”, can bring the wounded to the US within 3 days of their wounding, but the actual days depend on the individual patient’s condition.

Iraqui War

2005-2009 Casualties

- Among the 1,992,232 military service members who were deployed, there were 29,624 distinct combat wounds in 7,877 combat casualties.
- Mean age of the combat casualty cohort was 26.0 years.
- The combat casualties were predominantly male (98.8%), Army (77.5%), and junior enlisted (59.0%).
- The distribution of combat wounds was:
  - head/neck 28.1%
  - thorax 9.9%
  - abdomen 10.1%
  - extremities 51.9%.

Iraq War

Military Medicine Issues

- Explosive injury mechanisms accounted for 74.4% of all combat casualties, significantly higher than those caused by gunshot wounds (19.9%).

- From 2005 to 2007, explosive mechanisms of injury were significantly more common in Iraq than in Afghanistan.

- The percentage of explosive mechanisms increased significantly in Afghanistan between the years 2007 (59.5%) and 2008 (73.6%).

Iraq War

Military Medicine Issues

- Case-fatality rates in Afghanistan and Iraq represent the lowest mortality in US military history, but were higher at the outset of each conflict.

- Increased use of tourniquets, more blood transfusions, and rapid pre-hospital transport times were associated with 44% of reductions in mortality.

- Military trauma system advancements cause increased survival, and that, in turn, stimulates further advances.

Iraq War

Military Medicine Issues

- The wounding patterns observed in Iraq and Afghanistan from 2005 to 2009 differ from previous conflicts.

- Explosive mechanisms accounted for 74·4% of combat casualties, which is a higher percentage than in previous US conflicts.

- In Afghanistan, a progressive increase in the use of explosive mechanisms was seen, eventually equaling that in Iraq.

Iraq War

Acinetobacter

Injured soldiers from Iraq brought cases of multidrug-resistant *Acinetobacter baumanii* infection to military hospitals.

It is not known how this appeared among soldiers and whether the drug resistance is produced by antibiotic use or is characteristic of the strains infecting the troops.

Data from 442 soldiers seen at Walter Reed showed that 37 (8.4 %) were culture-positive for *Acinetobacter,* a rate far higher than any previously experienced.

The organism has infected wounds and prostheses and caused catheter-related sepsis in soldiers and in at least three other hospital patients.

Medical evacuees from Iraq are now routinely isolated on arrival and screened for the bacteria.

Iraq War

Civilian and Military Effects

- The 2013-2017 war caused at least 155 K deaths, and the displacement of more than 3.3 M people within the country.
- An estimated 151 K to 1.03 M Iraqis died in the first three to five years of conflict.
- 61% of total deaths were civilians with tens of thousands of military deaths.
- The majority of deaths occurred as a result of the insurgency and civil conflicts between 2004 and 2007.

Iraq War

Civilian and Military Effects

- Perhaps the most pressing difficulties arise from the changing conditions of the war.
- Medical teams were designed and outfitted for lightning-quick, highly mobile military operations.
- The war has proved to be slow-moving and protracted.
- To adapt, CSHs have had to be converted into fixed facilities.

Iraq War

Civilian and Military Effects

- In Baghdad, for example, the 28th CSH took over and moved into an Iraqi hospital in the Green Zone.
- Increasing numbers of Iraqi civilians come seeking care, and there is no overall policy about providing it.
- Some hospitals refuse to treat civilians for fear that some may be concealing bombs.
- Others are treating Iraqis but get overwhelmed, particularly by pediatric patients, for whom they have few supplies and limited personnel.

Iraq War

Civilian and Military Effects

- As the medical needs facing the military have increased, the supply of medical personnel has gotten tighter.
- Many surgeons were on a second or an extended deployment, but this has not been sufficient.
- As a result, military urologists, plastic surgeons, and cardiothoracic surgeons have been tasked to fill some general surgeon positions.
- Planners are having to contemplate pressing surgeons into yet a third deployment.

Iraq War

A Physician's Story

- Dr. M. Taylor began his Army service as an Army surgeon in 2001, to fulfill the terms of his military scholarship to med school.
- He was deployed twice to Iraq: February-May 2003 and August 2003-April2004.
- In March, 2004, outside Fallujah, 4 days from returning home to California, while making a telephone call outside his barracks, he was hit by a rocket-propelled grenade.
- Despite his team's efforts, he could not be revived.
- None among us have paid a greater price.

WAR in AFGHANISTAN
2001-2021

Afghanistan War

Joint Theatre Trauma Registry

- The JTTR was compiled by the USA and UK military, to detail injuries sustained and learn from experience.

- To ensure that military personnel injured on the battlefield have the “optimal chance for survival and maximum potential for functional recovery”.

- Medical personnel treated military personnel and civilians who had sustained severe injuries including gunshot wounds, stab and shrapnel injuries, burns and blast injuries.

Afghanistan War

Military Medicine Issues

- A surgeon faced with conflict injuries, needs to have a specific skill and knowledge set:
  - DCS (damage control surgery)
  - Vascular shunts
  - Surgical shortcuts
  - Updated global ICU care

- But the magic word when dealing with war trauma is **Team.**

- Having a skilled surgeon is vital, but perfectly trained and drilled people on the team have a very large impact on the definitive results of care.

Afghanistan War

Military Medicine Issues

- As many U.S. soldiers have been injured in combat in this war as in the Revolutionary War, the War of 1812, or the first five years of the Vietnam conflict, from 1961 through 1965.

- But a far larger proportion of soldiers are surviving their injuries.

- The military medical system has made fundamental and effective changes in the strategies and systems of battle care, even since the Persian Gulf War.

Afghanistan War

Military Medicine Issues

- Though firepower has increased, lethality of wounds has decreased.
- In WW II, 30% of Americans injured in combat died.
- In Vietnam, the proportion dropped to 24%.
- In the war in Iraq and Afghanistan, about 10 % of those injured have died.

Afghanistan War

Military Medicine Issues

- Combat deaths measure the magnitude and dangerousness of war, just as murder rates measure the magnitude and dangerousness of violence in our communities.

- The medical system is fundamentally important in determining whether or not someone dies, and not just the enemy's weaponry

- U.S. homicide rates have dropped to mid-1960's levels, yet aggravated assaults with firearms, have more than tripled during that period.

- The difference seems to be our trauma care system: mortality from gun assaults has fallen from 16% in 1964 to 5% today.

Afghanistan War

Military Medicine Issues

- Each FST is equipped to move directly behind troops and establish a functioning hospital with four ventilator-equipped beds and two operating tables within 60 minutes.

- The team travels in six Humvees, and carries 3 light-weight, Deployable Rapid Assembly Shelter (DRASH) tents that can be attached to one another to form a 900-square foot facility.

- Supplies to immediately resuscitate and operate on the wounded arrive in five backpacks:
  - an ICU pack
  - a surgical-technician pack
  - an anesthesia pack
  - a general-surgery pack
  - an orthopedic pack

Afghanistan War

Military Medicine Issues

- The packs hold sterile instruments, medicines, drapes, gowns, anesthesia equipment, catheters, and a handheld unit which can perform a hemogram, electrolytes levels, or blood gases with a drop of blood.

- FST's also carry a small ultrasound machine, portable monitors, transport ventilators, 20 units of packed red cells, and six roll-up stretchers with their litter stands.

- Orthopedic surgeons detect fractures by feel and apply external fixators.

- FST's can evaluate, and perform surgery on as many as 30 wounded soldiers, but cannot provide more than 6 hours of post-operative intensive care.

Afghanistan War

Military Medicine Issues

- The system took some getting used to, because surgeons at every level initially tended to hold on to their patients, either believing that they could provide definitive care themselves or not trusting that the next level could do so.

- According to statistics from Walter Reed, during the first few months of the war, it took an injured soldier an average of eight days to go from the battlefield to a U.S. facility.

- Gradually, the surgeons embraced the wisdom of the system.

- The average time from battlefield to arrival in the United States is now less than four days. (In Vietnam, it was 45 days.)

Afghanistan War

Military Medicine Issues

- One airman with devastating injuries from a mortar attack outside Balad on September 11, 2004, was on an operating table at Walter Reed just 36 hours later.

- He had bilateral thigh injuries, abdominal wounds, shrapnel in the right hand, and facial injuries, he was taken from the field to the nearby 31st CSH in Balad.

- Bleeding was controlled, volume resuscitation begun, a guillotine amputation at the thigh performed, he underwent a laparotomy with diverting colostomy, and his abdomen was left open, with a clear plastic covering.

Afghanistan War

Military Medicine Issues

- He was then taken to Landstuhl by a Critical Care Transport team.
- When he arrived in Germany, Army surgeons continued resuscitation, performed further washout, and sent him on to Walter Reed.
- There, after weeks in intensive care and multiple operations, he did survive, which is itself very remarkable.

Afghanistan War

Military Medicine Issues

- Injuries like his were unsurvivable in previous wars, but the cost can be very high.

- The airman lost one leg above the knee, the other in a hip disarticulation, his right hand, and part of his face.

- How he and others like him will be able to live and function remains an open question

Afghanistan War

Combat Support Hospitals (CSH)

- Two CSHs with four sites now exist in Iraq; these are 248-bed hospitals with six operating tables, some specialty surgery services, and radiology and laboratory facilities.

- Being mobile, they arrive in modular units by air, tractor-trailer, or ship and can be fully functional in 24 to 48 hours.

- Even at the CSH level, the goal is not necessarily definitive repair. The maximal length of stay is intended to be three days.

Afghanistan War

Combat Support Hospitals (CSH)

- The policy is to transfer any American soldier who requires more care to a level IV hospital: Kuwait, Rota, Spain, or Landstuhl, Germany.

- If expected to require more than 30 days of treatment, wounded soldiers are to be transferred to the US, mainly to Walter Reed or to Brooke Army Medical Center in San Antonio, Texas.

- Iraqi prisoners and civilians, on the other hand, receive all their care in Iraq.

Afghanistan War

Forward Surgical Teams

- When wounded arrive, FST's carry out the standard Advanced Trauma Life Support (ATLS) protocols that were developed by civilian trauma teams.

- Because of the high incidence of penetrating wounds (80 % of casualties seen by most FST's were gunshot wounds, shrapnel injuries, or blast injuries), lifesaving surgical management is needed more frequently than in civilian trauma centers.

- Today, military surgical strategy aims for damage control, not definitive repair, unless it can be done quickly.

Afghanistan War

Blast Injuries

- Early in the war, Kevlar vests proved dramatically effective in preventing torso injuries.
- But surgeons found that IED's cause blast injuries that extend upward under the armor and inward through axillary vents.
- They also produce what orthopedists term "mangled extremities": limbs with severe soft-tissue, bone, and often vascular injuries.

Afghanistan War

Blast Injuries

- These can be devastating, potentially mortal injuries, and whether to amputate is one of the most difficult decisions in orthopedic surgery.

- Military surgeons have relied on civilian trauma criteria to guide their choices, but those criteria have not proved useful in this war.

- Because the limb injuries are more extreme or more often combined with injuries to other organs, attempts to salvage limbs following those criteria frequently fail, with life-threatening blood loss, ischemia, or sepsis.

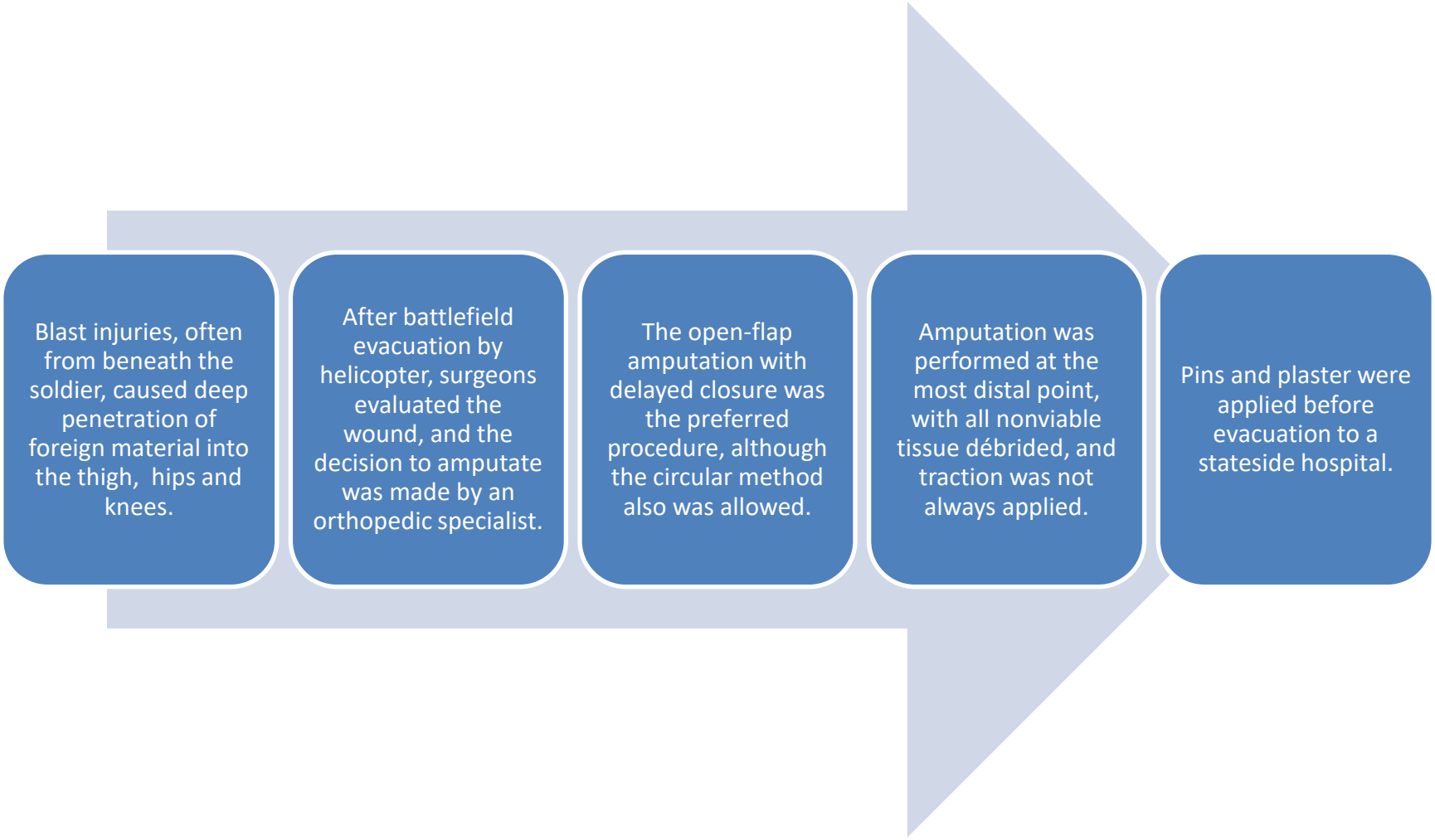
Afghanistan War

Blast Injuries

- Blast injuries from suicide bombs, land mines and IED's proved particularly difficult to manage.
- Often combine penetrating, blunt, and burn injuries, and the shrapnel includes nails, bolts, steel balls, dirt, and clothing.
- Victims of IED attacks can exsanguinate from multiple small wounds, especially those in the back.
- Teams have learned to pack bleeding sites before laparotomy or other surgeries are performed.

Afghanistan War

Blast Injuries



Afghanistan War

Other Injuries

- Surgeons found a very high incidence of blinding injuries.
- Soldiers had been told to wear eye protection, but they found the issued goggles too ugly.
- Some soldiers said “They look like something a Florida senior citizen would wear.”
- So the military bowed to fashion and switched to cooler-looking Wiley-brand ballistic eyewear, and the rate of eye injuries markedly decreased.

Afghanistan War

Sample One-day Case List

The case list from October 21, 2004 provides a picture of the extent of the injuries:

- one gunshot wound
- one antitank-mine injury
- one grenade injury
- three rocket-propelled–grenade (RPG) injuries
- four mortar injuries
- eight IED injuries
- seven patients with unknown cause of injury

Interventions included:

- partial hand amputation
- right hip disarticulation
- left through-knee amputation
- open pelvic débridement
- left nephrectomy and colostomy
- axillary artery and vein reconstruction
- splenectomy
- repair of a degloving scalp laceration and through-and-through tongue laceration.

None of the soldiers were more than 25 years of age.

Medical Management Vietnam

- During the Vietnam War, semiautomatic rifles with high-velocity rounds caused considerable soft tissue damage, and patients frequently sustained multiple wounds from bursts of automatic fire or booby traps.

- Surgeons could receive patients as early as 1 to 2 hours after wounding, although, conditions during combat often delayed evacuation and resulted in an arrival time of 4 to 6 hours after wounding.

- The wounds were débrided, lavaged, packed open with occlusive dressing, and the patient was infused with Ringer's lactate and antibiotics; secondary closure of the wound usually could be accomplished in 7 days.

Medical Management

Vietnam

- Fractures were treated by reduction and initial traction or casting depending on the severity of the wounds, but patients with complex fractures and vascular injuries typically were treated by vascular and orthopedic specialists.

- Wounds with massive soft tissue damage were covered with occlusive dressings or a mesh graft.

Medical Management Korea

- In Korea, combat medics worked to resuscitate the wounded before they were transported by helicopter or land ambulance.

- Pressure dressings were applied as a first resort to control bleeding; guidelines stated tourniquets should be used only if pressure dressings were not sufficient.

- The medic could begin antibiotic therapy and transfuse blood if transport could not happen for 4 to 5 hours.

- Extremity wounds and fractures were débrided, left open and immobilized with *splints* and plaster.

Afghanistan War

Blood Supply

- After Vietnam, the US military maintained its capacity to collect, package, and transport blood.
- Improvements in anticoagulants and technology to freeze blood greatly enhanced its efforts.
- During the 1991 Gulf War, the ASPB shipped more than 100,000 units to troops in theater and currently operates 21 donor centers and 81 transfusion centers in the United States, Europe, and Asia.

Iraq And Afghanistan Wars

Antibiotics

- In Iraq and Afghanistan, broad-spectrum antibiotics generally are not administered during early treatment, and antibiotic therapy is directed by cultures taken on admission to US military hospitals.

- In addition to methicillin-resistant *Staphylococcus aureus* (MRSA), other resistant strains of pathogens have been found in US war wounds.

- One survey of infections from CSH in Iraq from 2003-2004 showed the most commonly isolated bacteria from clinical infections in US troops were *coagulase-negative staphylococci (34%)*, *Staphylococcus aureus* (26%), and *streptococcal* species (11%).

Iraq And Afghanistan Wars

Antibiotics

- The 732 cultures obtained from the mainly Iraqi population included mostly gram (-) bacteria:
  - *Klebsiella pneumoniae* (13%),
  - *Acinetobacter calcoaceticus-baumannii* complex (11%)
  - *Pseudomonas aeruginosa* (10%).

- Gram (-) and gram (+) bacteria were resistant to a broad array of antimicrobial agents .

Iraq And Afghanistan Wars

Wound Care

- Goal is to promote healing, treat and prevent infections.

- More severe wounds require care with sterile dressings:
  - dry dressings
  - wet-to-dry dressings
  - chemical-impregnated dressings
  - foam dressings
  - alginate dressings
  - hydrofiber dressings
  - transparent film dressings
  - hydrogel dressings
  - hydrocolloid dressings.

- All of them require additional materials to complete the dressing

Afghanistan War

Other Therapies: Leeches & Maggots

- Medical leeches were cleared for use in 2004 because components of their saliva have the ability to assist with compromised tissue.

- Their saliva contains a local anesthetic, a thrombin inhibitor, has antibiotic properties and a histamine-like vasodilator.

- The leeches dilate the blood vessels and produce blood flow, very helpful in operations where blood clots occur.

Afghanistan War

Other Therapies: Leeches & Maggots

- Maggots work as biomedical debriding agents by ingesting bacteria and breaking them down within their intestines.

- Maggots give off an enzyme that disinfects wounds and promotes healing and this is why they became the first organism used as a medical device in January 2004.

MEDICAL INNOVATIONS

Tourniquets

- Used by the U.S. military since the Civil War, they play an important part in stopping the flow of traumatic bleeding by constriction.

- Per the Army Medical Command, nearly 50% of combat deaths since World War II can be attributed to blood loss.

- The war in Afghanistan prompted the invention of the one-handed tourniquet in 2002, so soldiers could apply pressure to bleeds without assistance.

- In 2005, the Combat Application Tourniquet (CAT) was issued to all Army soldiers, and became incorporated into civilian trauma care.

Tourniquets (CAT)

Battlefield Dressings

- Since 2002 there have been many innovative changes in blood-clotting dressings, like the fibrin bandage, the chitosan bandage, combat gauze, and kaolin gauze pads.

- Developed jointly by the US Army and the American Red Cross, the fibrin bandage clots proteins in the blood with fibrinogen (glycoprotein) and thrombin (enzyme), it reduces blood loss by 50 to 85%. *

- The chitosan bandage staunches bleeds by combining a biodegradable carbohydrate found in the shells of shrimp and lobsters with human blood cells.

- In 2008, combat gauze dressing became standard issue in the Improved First Aid Kit for every deploying soldier.

- Kaolin gauze pads (QuikClot) prompt the natural coagulation response, resulting in reduced hemorrhage.**

Battlefield Dressings
XStat

In 2014, researchers announced XStat, a pocket-sized injector that inserts up to 92 medical sponges into a wound and can halt bleeding within 15 seconds.

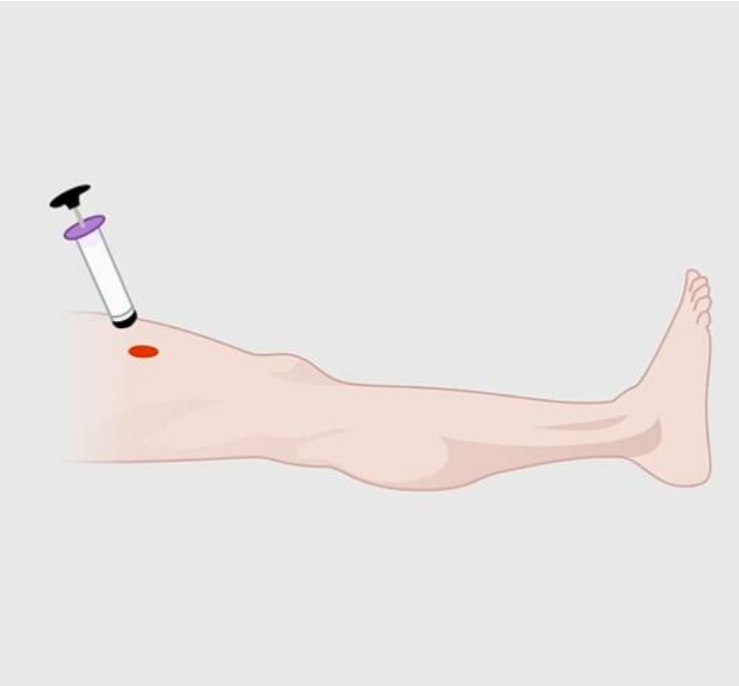
Only injectable wound treatment that immediately controls hemorrhage from penetrating wounds like gunshots and shrapnel.

First-in-kind hemostatic device, applies in seconds and stops bleeding immediately without manual compression

It works by injecting small, rapidly-expanding sponges into a wound cavity using an easy to learn and easy to use intuitive syringe-like applicator.

Developed in collaboration with the US Military.

Battlefield Dressings
XStat



Golden Hour Blood Container

- Army needed a container to carry blood that could operate in Afghanistan's desert and mountains and maintain the cells without freezing or cooking them.
- In order to be transfused, blood must be preserved at a temperature of 34 to 43 degrees F.
- The container cools up to 4 units of blood and provides more time to transport it.
- The container has panels inside that are frozen ahead of time, and as the panels thaw, everything inside stays at 39 degrees F for about 72 hours, depending on the temperature outside.

Golden Hour Blood Container

- They are built using high performance PCM (phase change material) for coolant and VIPs (vacuum insulated panels) for superior insulation.

- It is still in use today, not only in the U.S. military and civilian medical communities, but also in other countries.

- The box is used for other temperature-sensitive, life-saving medical supplies, platelets, vaccines and medications, during emergencies as well as on the battlefield today."

Pain Management

- In 2006, pain management advancements included a lozenge containing analgesic that provided pain relief, but did not sedate the patient.

- That same year officials at the U.S. Army Medical Department Center approved an advanced regional anesthesia, which blocks nerves in the affected areas for patients requiring surgery.

Iraq War

- According the U.S. Department of Veterans Affairs, 6% of service members wounded in Iraq experienced amputation.
- Advancements in prosthetics include the developments of robotic prosthetics and vacuum-assisted suction sockets for hip disarticulation.
- According to a MEDCOM fact sheet, more than 250 service members with amputation returned to active duty and more than 50 deployed again.

Traumatic Brain Injury

- Often referred to as the signature wound of the wars in Iraq and Afghanistan, significant attention has been paid to identifying and treating traumatic brain injuries.
- In 2001, the U.S. Army Medical Research and Materiel Command began studying biomarkers for TBI, analyzing hundreds of TBI patients and funding studies to diagnose and treat brain injuries.
- A Department of Defense-sponsored study, which began in 2012, involved the use of hyperbaric oxygen therapy, which exposes patients to pure oxygen, increasing the amount of oxygen red blood cells and body tissue absorbed, which, in theory, can change the way the body heals.

Regenerative Medicine

- To meet the demands of treating severely wounded service members, DoD officials established the Armed Forces Institute of Regenerative Medicine in 2008.

- Devoted to service members with “debilitating, disabling and disfiguring extremity injuries and burns,” the institute focuses its research in five areas:
  - burn repair
  - compartment syndrome repair
  - craniofacial reconstruction
  - limb and digit salvage
  - scarless wound healing

Vaccine Development

- Since the 1960s, the U.S. military has played a role in the development of eight licensed vaccines including Rubella, Hepatitis B and Hepatitis A.

- In 2011, the military adopted the Adenovirus vaccine, types 4 and 7, to prevent acute respiratory disease because the virus can thrive in barrack-type environments, and the illness often results in lost training time.

- The vaccine gained approval in 2011 by the FDA after testing and evaluation of the new vaccine was completed at Army and Navy basic training camps.

Ultrasound Imaging

- Another technique developed by the military, hand in hand with civilian medics is the use of portable ultrasound.
- This is used not only for scans but also for pain control by allowing surgeons to locate and anaesthetize individual nerves.
- Ultrasound was itself a product of war, first used by tank engineers in World War Two to detect cracks in armor.
- Today it is used for everything from scanning pregnant women to looking for cancers.

Human Effects of War

- Due to improved medical care during their tours of duty, troops serving in the Iraq and Afghanistan conflicts were able to survive injuries that would have been fatal in previous wars.

- Although this cohort makes up only 24 percent of all living veterans, it accounts for more than half of the severely disabled veteran population in America.

- Over one million post-9/11 veterans have significant disabilities.

Intraosseous Infusion (IO)

- Process of injecting medications, fluids, or blood products directly into the marrow of a bone, and provides fluids and medication when intravenous access is not available or not feasible.

- The administered medications and fluids go directly into the vascular system.

- Alternative to the preferred intravascular route when it cannot be established in a timely manner in emergent situations and patients need immediate delivery of life-saving fluids and medications.

Fiberoptic Intubation

- Combines traditional laryngoscope with a fiberoptic light source and video capability.
- Has a screen that allows visualization of larynx and increases success of intubation.
- Portable, lightweight, rechargeable, easy to use, can go to the patient's battlefield bedside.
- Decreases complications and failed intubations.

Injuries

- Bullets spin on their axis when exiting a weapon but begin to wobble as the distance from the weapon increases.
- Once the bullet enters the body, it tumbles and often reverses orientation so that the heavy end of the bullet takes the lead.
- This reversed orientation, augmented by pressure waves created by the projectile as it passes through tissues, creates a temporary cavity.
- In this manner, solid organs such as the liver or spleen are damaged to a much greater extent than tissues that stretch easily, such as muscle.

US Servicemen Hospital Mortality

Armed Conflict	Hospital Mortality
War of Independence	25%
Civil War	14%
First World War	6%
Second World War	4.5%
Korean War	2.5%
Vietnam	1.8%

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War	Wounded/KIA	Killed in Action	Lethality %
Revolutionary War (775-1783)	10,623	4,435	42
War of 1812 (1612-1815)	6,765	2,260	33
Mexican War (1846-1848)	5,885	1,733	29
Civil War, Union Army (1861-1865)	422,295	140,414	33
Spanish-American War (1898)	2,047	385	19
World War I (1917-1918)	257,404	53,402	21
World War II (1941-1945)	963,403	291,557	30
Korean War (1950-1953)	137,025	33,741	25
Vietnam War (1961-1973)	200,727	47,424	24
Persian Gulf War (1990—1991)	614	147	24
Iraq & Afghanistan Wars (2001-2004)	10,369	1,004	10

Department of Defense 2004