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FELLOWSHIP PAPER

DAMAGE CONTROL SURGERY AND THE JOINT SOLUTION



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EXECUTIVE SUMMARY

The following paper discusses the notional ideas of interchangeability and interoperability within the three main branches of the Department of Defense as well as the current struggle of the Services to effectively meet damage control surgery requirements for combatant commanders. Through a brief discussion of the major conflicts leading from World War I to the present fight against the Islamic State of Iraq and Syria, background information will be presented in a condensed form to give perspective on successes and challenges faced by the military health system over time. Additionally, the new concepts of military strategy are discussed with implications for casualty care. Lastly, a short excerpt on how each Service organizes, trains and equips their personnel for the delivery of damage control surgery will be explored. The information presented leads to three proposed courses of action as future opportunities to advance conceptual modeling/philosophy and Service-level planning for rotational and emergent scenarios. While many aspects of this paper are notional/abstract, the topical information is prescient to current discussions within the military health system as it supports America's foreign policy interests and diplomacy.

I. Introduction

What does it mean to work in a shared service role in the United States Military? There are some intellectuals who believe a shared service is interchangeable between branches of the military, while others believe there is opportunity for interoperability but not interchangeability based upon how the military branches employ personnel. This paper will discuss the definitions of interchangeability and interoperability variables in the military regarding employment of medical personnel and examine the shared service role of Damage Control Surgery (DCS) when leveraging medical capability in the Joint health service environment.

II. PAST AND CURRENT MEDICAL DOCTRINE

To properly plan for the future, it is extremely important to acknowledge and learn from past events in order to give weight and meaning to current efforts for future planning consideration. Beginning with the first documented use in World War I through the present day, DCS has advanced through technology and associated services to enhance the battlefield surgical intervention survivability rates. Appendices A-E incorporate medical advancements and lessons learned from the major conflicts America has been involved in over the last 100 years. The information provided is not the complete historical account for each conflict, but represent general highlights to shape the definition of DCS, its critical importance to military support, and the employment and training factors that have a profound effect upon its delivery.

As a synopsis of past historical medical doctrine, military medicine evolved into a system of echelons of care beginning with point of injury (POI) care, damage control surgery for stabilization, movement to enable restorative surgery, and ultimately, rehabilitative intervention and care in the U.S. In tandem with ground medical evolution, patient movement also progressed from litter bearers and trains to all terrain ambulances for casualty evacuation (CASEVAC) to both rotary and fixed wing aeromedical evacuation to synthesize the ground medical levels of echelon care. Current medical doctrine, which began during the Iraq Wars, 1990-2011, has remained largely unchanged, minus technological upgrades to older pieces of equipment used for the delivery of care and casualty evacuation, whereas casualties are brought by the most expedient method to the closest surgical capability for treatment and then evacuated to a theater hospital or out of the theater according to wound severity.

III. SHAPING FUTURE DOCTRINE

If there has been little to no change within the last 16 years, why is DCS suddenly so important and how can we enhance its delivery now and in the future? Technology certainly plays a vital role with adapting new methods for the delivery of healthcare and DCS to the COCOM. The enemy's ability to limit, by scope or concept, our numbers of personnel and weapons systems compromises operational planning norms and may dictate a much smaller footprint and potential regression back to Korean and Vietnam War style methods for casualty care and movement. This idea leads to the theories of Anti-Access/Area Denial (A2/AD) engagements, Air Sea Battle (ASB), Joint Access & Maneuver in the Global Commons (JAM-GC), Collaborative Operations in Denied Environments (CODE) and Military Operations in Denied Environments (MODE).

A2/AD

“ANTI-ACCESS: ENEMY ACTIONS WHICH INHIBIT MILITARY MOVEMENT INTO A THEATRE... THOSE ACTIONS AND CAPABILITIES, USUALLY LONG-RANGE, DESIGNED TO PREVENT AN OPPOSING FORCE FROM ENTERING AN OPERATIONAL AREA.

AREA-DENIAL: ACTIVITIES THAT SEEK TO DENY FREEDOM OF ACTION WITHIN [AN] AREA UNDER “THE ENEMY’S CONTROL”... THOSE ACTIONS AND CAPABILITIES, USUALLY OF SHORTER RANGE, DESIGNED NOT TO KEEP AN OPPOSING FORCE OUT, BUT TO LIMIT ITS FREEDOM OF ACTION WITHIN THE OPERATIONAL AREA.”¹

There are some military leaders that think the term “A2/AD” has come to obscure more than it illuminates an enemy's strategy, and that it focuses too tightly on the idea of defensive bubbles without fully expressing the complexity of fighting inside and outside systems of defense, and therefore is no longer relevant or useful to operational planning.² Instead, it may “effectively represent a particular manifestation of a long-running strategic problem characterized by the threat of a previously unachievable degree of coordination between different tools of national defense, geared towards winning freedom of movement in a constrained maritime space.”³ The country of China, given its recent military

¹ Unknown Author. “Anti-Access and Area Denial (A2AD).” Naval War College PowerPoint Presentation. Accessed on 13 Feb 17 from: [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&uact=8&sqi=2&ved=0ahUKewjZwd-](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&uact=8&sqi=2&ved=0ahUKewjZwd-k8rSAhXJOyYKHLC2YQFggpMAM&url=https%3A%2F%2Fwww.usnwc.edu%2Fgetattachment%2F3e3ba751-8674-4175-9672-404d967f4355%2F8---A2AD.aspx&usq=AFQjCNGHN2N9D9k0EwF52tMvCtPo2Znocw)

[k8rSAhXJOyYKHLC2YQFggpMAM&url=https%3A%2F%2Fwww.usnwc.edu%2Fgetattachment%2F3e3ba751-8674-4175-9672-404d967f4355%2F8---A2AD.aspx&usq=AFQjCNGHN2N9D9k0EwF52tMvCtPo2Znocw](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&uact=8&sqi=2&ved=0ahUKewjZwd-k8rSAhXJOyYKHLC2YQFggpMAM&url=https%3A%2F%2Fwww.usnwc.edu%2Fgetattachment%2F3e3ba751-8674-4175-9672-404d967f4355%2F8---A2AD.aspx&usq=AFQjCNGHN2N9D9k0EwF52tMvCtPo2Znocw)

² Farley, Robert. “A2/AD Is Dead, Long Live A2/AD.” The Diplomat, 11 Oct 16. Accessed on 13 Feb 17 from: <http://thediplomat.com/2016/10/a2ad-is-dead-long-live-a2ad/>

³ *Ibid*, 2.

technological advances and shaping activities in its coastal waters, provides a great example to learn from.

Technology advancements have enabled China's navy to operate within range of shore fire support throughout vast coastal sea areas and the ships are no longer confined within a short radius of a single point along the coast. This ability has been made possible by static and mobile DF-31D and DF-26 anti-ship ballistic missile systems to provide protective cover for China's warships operating beyond the first island chain and potentially beyond the second island chain if the DF-26 reaches the upper limit of its estimated firing range.⁴ In other words, China is able to strike at enemy fleets throughout the waters of the Western Pacific and East and South China seas, while the mobile units can be positioned for focus effects to concentrate fire near targets. Additionally, China has begun island building in neutral waters for the purpose of airstrips and missile/artillery batteries to further extend its operational reach. However, A2/AD is about more than firepower. It is a strategy likened to theory from Carl von Clausewitz, who reminds us that the "community of interest" constitutes the "center of gravity" for multinational consortiums and that disruption of the community through an effective military blow can splinter the alliance into manageable pieces.⁵

An effective counter to China's missile batteries would be the use of our own anti-ship and anti-air missiles deployed to key target areas with offensive sea mines in common straits to finish off the deterrence followed closely behind with submarines to fill gaps in coverage.⁶ Meanwhile, allied submarines could slip into the Yellow and East China seas to stop their import and export of resources and goods needed for sustainment, turning our military action into economic dividends and potentially driving China to concessions.⁷ The preceding military strategy becomes a shaping activity for the next evolution in denied environment fighting.

ASB & JAM-GC

The Air Sea Battle (ASB) concept was created in 2009 to counter emerging A2/AD threats during the Iraq and Afghanistan conflicts.⁸ Long before the 21st century, the sea was the only global common which needed to be fought over. However, as time and technology advance forward, the definition of the

⁴ Holmes, James R. "Defeating China's Fortress Fleet and A2/AD Strategy: Lessons for the United States and Her Allies." *The Diplomat*, 20 Jun 16. Accessed on 13 Feb 17 from: <http://thediplomat.com/2016/06/defeating-chinas-fortress-fleet-and-a2ad-strategy-lessons-for-the-united-states-and-her-allies/>

⁵ *Ibid*, 4.

⁶ *Ibid*, 4.

⁷ *Ibid*, 4.

⁸ LaGrone, Sam. "Pentagon Drops Air Sea Battle Name, Concept Lives On." U.S. Naval Institute, 27 Apr 17. Retrieved on 5 Jul 17 from: <https://news.usni.org/2015/01/20/pentagon-drops-air-sea-battle-name-concept-lives>

global commons changed and now includes the spaces and dimensions on, above or throughout the earth belonging to no one nation and can be used according to international law and customs.⁹ Therefore, the air above the oceans, space, and the cyber realm all fit into the contested environment. This new twist to the ASB theory has led to the more refined concept of all-domain access named Joint Access and Maneuver in the Global Commons (JAM-GC).¹⁰ The principles of JAM-GC seek to identify capability gaps, integrated counter-A2/AD solutions and help shape the DOTMLPF (Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities) factors pertaining to the inherent operational challenges. Within the JAM-GC construct, each Service must embrace the all-domain concept to fully develop their Title 10 authorities to implement operational problem solutions.¹¹ The solutions require a particular set of characteristics for the joint force in the following ways:

“Distributable: “the ability to disperse, reposition, and use a variety of bases and operating locations, while retaining the ability to maneuver and concentrate combat power”

Resilient: “the ability to recover rapidly from adversity and setbacks, which usually come in the form of combat losses”

Tailable: Forces available to the joint force commander that “can be readily commanded, controlled, and employed in any necessary temporary or permanent structure to accomplish assigned missions”

Sufficient scale: Examples of increasing capacity include increasing range, carriage, and loiter times of existing platforms; expanding the number of partners conducting operations together; and increased use and integration of commercial systems.”

Ample duration: U.S. and allied forces must have necessary “staying power.” A key feature must be a logistics system that provides redundancy and timely access to resources to withstand interruption, corruption, and attrition.”¹²

⁹ Tangredi, Sam J. “Commons Control and Commons Denial: From JAM-GC to an Integrated Plan.” EMC Chair Conference Paper, U.S. Naval War College. Accessed on 5 Jun 17 from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&sqi=2&ved=0ahUKEwiNucnIsZ_UAhWGJCyKHepCCgEQFgg9MAQ&url=https%3A%2F%2Fwww.usnwc.edu%2Facademics%2Ffaculty%2FDerek-Reveron%2Fworkshops%2Fseapower-and-foreign-policy%2Fpapers%2FTangredi.aspx&usg=AFQjCNGgqCWJmvx-sd-msXGubKv_-RfSmQ

¹⁰ Armstrong, B.J. “The Shadow of Air-Sea Battle and the Sinking of A2AD.” War on the Rocks, 5 Oct 16. Accessed on 2 Jun 17 from: <https://warontherocks.com/2016/10/the-shadow-of-air-sea-battle-and-the-sinking-of-a2ad/>

¹¹ Kazianis, Harry J. “Air-Sea Battle's Next Step: JAM-GC on Deck.” The National Interest.Org, 25 Nov 15. Accessed on 5 June from: <http://nationalinterest.org/feature/air-sea-battles-next-step-jam-gc-deck-14440?page=2>

¹² Hutchens, Michael E., et al. “Joint Concept for Access and Maneuver in the Global Commons: A New Joint Operational Concept.” Joint Force Quarterly 84, 27 Jan 17. Accessed from National Defense University Press on 5 Jun 17 from: <http://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-84/Article/1038867/joint-concept-for-access-and-maneuver-in-the-global-commons-a-new-joint-operati/>

The multi-layered approach to the global commons is well represented from Figures 1-3 below, depicting the sea, land and air domain assets used as solutions for enemy aggression within the global commons:



Figure 1: Anti-Ballistic Missile fired from Navy Aegis Destroyer (Kaziannis, 25 Nov 15)



Figure 2: Soldiers conduct static line airdrop during Joint Operational Access Exercise 13-02, at Sicily drop zone, Ft Bragg, NC, to train with paratroopers from U.S. Army's 82d Airborne Division on projecting combat power in denied environments (DOD/Jason Robertson) (Hutchens, 27 Jan 17)



Figure 3: United Launch Alliance Delta IV-Heavy rocket carrying Nat'l Recon Office payload launches from Space Launch Complex-6, 28 Aug 13, at Vandenberg AFB (U.S. Air Force/Yvonne Morales) (Hutchens, 27 Jan 17)

CODE

The Defense Advanced Research Projects Agency (DARPA) has come up with the CODE program to help the U.S. military's unmanned aircraft systems (UASs) conduct dynamic, long-distance engagements of targets in denied airspace, while reducing the communication bandwidth requirement and human cognitive involvement.¹³ CODE's main objective is to prove the value of autonomy, in which UASs could "perform sophisticated tasks both individually and in teams under the supervision of a single human mission commander."¹⁴ Through continuous evaluation of their own states and environments, the UASs present data for coordinated actions to a mission supervisor, who would approve or disapprove the actions and direct any mission changes necessary to produce the desired effect.¹⁵ The algorithmic approach for collaborative autonomy enables the UAS to find, fix and engage targets as appropriate under established rules of engagement. This process allows mission commanders to adapt to dynamic situations faster and prevent attrition of friendly forces or the emergence of unanticipated threats.¹⁶ Figure 1 represents an artist's concept of CODE in an A2/AD environment.

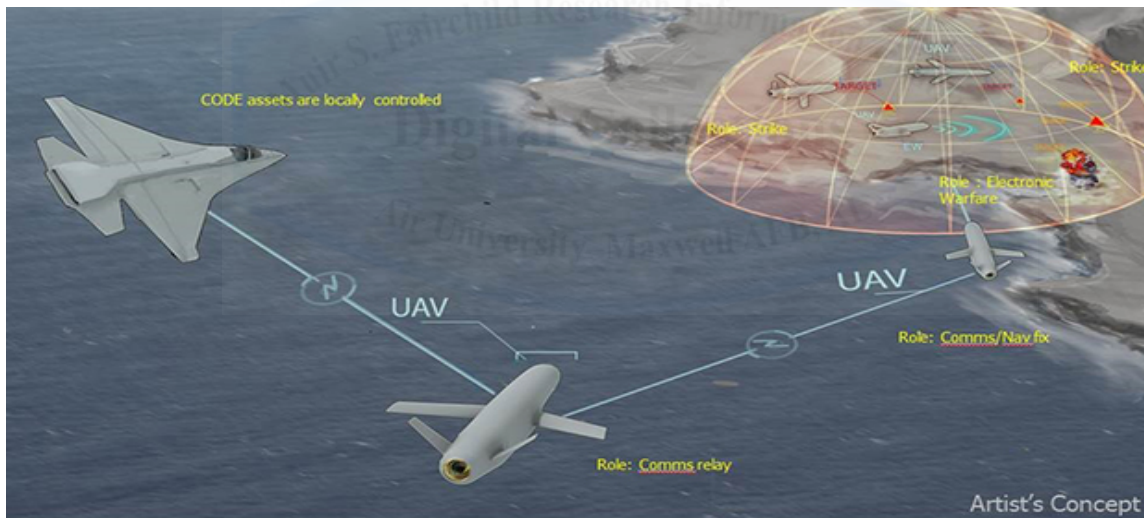


Figure 4¹⁷
MODE

¹³ Challer. "CODE Takes Next Steps Toward More Sophisticated, Resilient, and Collaborative Unmanned Air Systems." Armed With Science: The Official U.S. Defense Department Science Blog, 13 Jun 16. Accessed on 10 Feb 17 from: <http://science.dodlive.mil/2016/06/13/code-takes-next-steps-toward-more-sophisticated-resilient-and-collaborative-unmanned-air-systems/>

¹⁴ *Ibid*, 13.

¹⁵ Lede', Jean-Charles. "Collaborative Operations in Denied Environment (CODE)." Accessed on 10 Feb 17 from: <http://www.darpa.mil/program/collaborative-operations-in-denied-environment>

¹⁶ *Ibid*, 15.

¹⁷ *Ibid*, 15.

So, if the environment is denied, how do we effectively manage casualties? If the operation is purely kinetic, there is no need for medical intervention. However, if there is a limited number of ground troops in support of allied military maneuvers, our operational conditions shift into MODE. In MODE (which contains A2/AD concepts), logistical support to the operation, including medical assets to treat and evacuate casualties, will require joint planning to ensure host and partner nations can effectively house and assist with the employment of prepositioned medical storage solutions.¹⁸ The ability to sustain equipment sets and ensure dated item resupply, whether coordinated and exacted by contractual means or just-in-time resupply, will be crucial for effective casualty management, as movement of these items into the AOR would be problematic or impossible depending on enemy deny strategy and/or capability.

2016 NDAA (Changes to MTF Structure)

In addition to technology, policy also shapes future military doctrine through joint publications, Service publications and congressional mandates. The latest 2016 version of the National Defense Authorization Act (NDAA) is one of the policy documents creating change and helping to shape governance of the Military Health System (MHS) and the delivery of care. In particular for medical oversight and governance, the following is required:

“Section 702: 1) the Defense Health Agency (DHA) be responsible for administration of military medical treatment facilities, to include budgetary matters; 2) military medical facility commanders be responsible for ensuring the readiness of the members of the Armed Forces and civilian employees at the facility, and furnishing the health care and medical treatment provided at the facility; and 3) DoD will submit to Congress an implementation plan to establish a Joint Trauma System within the DHA to improve trauma care for members of the Armed Forces and other individuals who are eligible to be treated for trauma at a military medical treatment facility.

Section 708: 1) DoD will establish a Joint Trauma Education and Training Directorate to ensure that the traumatologists of the Armed Forces maintain readiness and are able to be rapidly deployed for future armed conflicts; 2) DoD authorized to enter into partnerships with civilian academic medical centers and large metropolitan teaching hospitals that have certain civilian trauma centers; and 3) DoD will establish a personnel management plan for specified wartime medical specialties.

Section 725: DoD will implement, and the GAO assess, specified measures to maintain the critical wartime medical readiness skills and core competencies of health care providers within the Armed Forces.”¹⁹

¹⁸ Kelly, Terrence K. and David C. Gompert and Duncan Long. “Smarter Power, Stronger Partners, Volume I.” RAND Corporation, 2016. Accessed on 13 Feb 17 from: www.rand.org/t/RR1359
¹⁹ S.2943 – National Defense Authorization Act for Fiscal Year 2017. 114th Congress, 23 Dec 16. Public Law No: 114-328. Accessed on 7 Mar 17 from: <https://www.congress.gov/bill/114th-congress/senate-bill/2943?q=%7B%22search%22%3A%5B%22ndaa+2017%22%5D%7D&r=3>

The above mentioned requirements highlight a fundamental change in reporting parameters for each Service's corporate medical structure. It also calls for a joint training entity to provide and plan readiness currency for "traumatologists." One can only assume traumatologists refers to the spectrum of healthcare to include resuscitative trauma and surgical care followed by critical follow-on care; and that it directly infers DCS as a future priority to be trained and planned for in a joint manner. So, if the Services are to think, plan and train jointly, understanding how each Service deploys their personnel will become more important.

IV. THE SERVICES' OPERATE, TRAIN AND EQUIP FOR DEPLOYMENT OF DCS

The Army

Army medical personnel are divided into two basic command structures, the Army Force Command, or FORCECOM, for rotational taskings and the Army Medical Command, or MEDCOM, for institutional medicine delivery. Army deployment allocations are assigned to FORCECOM for its presentation of forces in support of a combatant commander's requirements for the area of operation (AOR). The Army typically deploys at a ratio of 1:2 for a 36-month cycle, meaning a unit is available for deployment for 12 months and then transitions to a 24-month dwell period for reconstitution and training.²⁰ However, on the medical side, the Army will generally deploy one unit to satisfy a component-level tasking requirement and then rotate their surgeons every 90 days to enable surgical currency within their practice, help with Service retention and spread the burden of deployment across the entire MTF.

The Army approach for medical support is founded upon fundamental beliefs comprised of components and central ideas to prevent, shape or win wars. The Army must provide depth and versatility to the Nation, be responsive to COCOMs, and enable Joint Force 2020.²¹ There are two key central ideas and components relating to this paper's topic: support combatant commanders, operational adaptability, special operations and conventional force interdependence, and deploy despite anti-access/area denial.

Initial surgery for the Army normally occurs at Role 3 with resuscitation, initial wound/damage control surgery, and postoperative treatment, but casualties may receive DCS at POI or Role 1 by way of advanced trauma management and far forward resuscitative surgery prior to movement.²² The Forward

²⁰ Army Regulation 525-29, Army Force Generation, 14 Mar 11, Pg 2.

²¹ Pasek, Gabriella M, USA LTC. "U.S. Army Structure and Health Service Support Capabilities." PowerPoint presentation, Joint Medical Operations Course, 8 Mar 16.

²² Pasek, Gabriella M, USA LTC. "U.S. Army Structure and Health Service Support Capabilities." PowerPoint presentation, Joint Medical Operations Course, 8 Mar 16.

Surgical Team (FST) is the current doctrinal approach to DCS. The FSTs mission is to provide a modular rapidly deployable urgent, initial surgical service forward in the brigade area of operations (AO).²³ The FST can be configured to support a single operation with full complement of 20 personnel or split into two teams of 10 personnel for multiple fronts. Figure 5 below shows the breakdown of the current FST structure.

Army Forward Surgical Team (Current FST - 20 PAX)		
MSN	PAX TYPE	PAX
Up to 72-hrs continuous ops w/Med Co spt; DCS for up to 30 cases; 8-hrs post-op care; team can augment Role 3 CSH	FST Chief/General Surgeon	1
	General Surgeon	2
	Ortho Surgeon	1
	Preop Nurse	1
	OR Nurse	2
	CRNA	2
	MS Officer	1
	Det Sgt	1
	OR Tech	3
	ER Tech	3
	Nurse	3

Figure 5

For the fiscal year '18 operational planning cycle, the Army has shifted the structure of the FST slightly to what is represented in the Figure 6 below.

Army Forward Surgical Resuscitative Team (FY18 FRST - 20 PAX)		
MSN	PAX TYPE	PAX
Complete FRST: Up to 72-hrs continuous ops w/Med Co spt; DCS for up to 30 cases; 8 pax 6-hrs post-op care Split Base: Up to 12 DCS cases of 72-hrs w/4 pax 6-hrs post-op care	FST Chief/General Surgeon	1
	General Surgeon	1
	Ortho Surgeon	2
	ER Physician	2
	OR Nurse	4
	CRNA	2
	MS Officer	1
	Det Sgt	1
	OR Tech	2
	ER Tech	2
	Nurse	2

Figure 6

This Force Design Update (FDU) modernizes the surgical procedure list and surgical skills mix to meet current and expected wound distribution patterns while enhancing DCR skills mix, providing an autonomous element for greater pre and post op critical and emergency nursing care at the expense of

²³ *Ibid*, 22.

operative nursing support.²⁴ However, the new change did not fit the lower foot print required by COCOMs in support of SOCOM operations.

As a response the Army has developed and implemented two far forward non-doctrinal DCS teams in the field for resuscitative/damage control surgery in support of Special Operation Forces/Missions outside of the 60 minute MEDEVAC (medical evacuation) ring.²⁵ It is known as the Golden Hour Offset Surgical Trauma Team (GHOSTT). Figure 7 below shows the GHOSTT's capabilities and planning considerations.

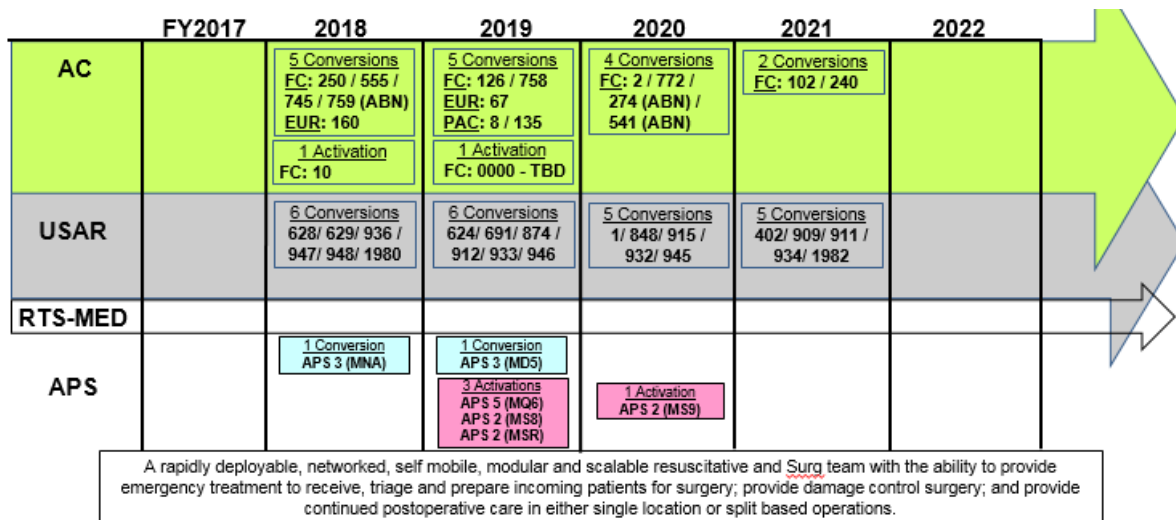
Army Golden Hour Offset Surgical Trauma Team (GHOSTT - 5-10 PAX) Protocol				
Lite (5 PAX)			Heavy (8-10 PAX)	
PAR	PAX	PAX TYPE	PAX	PAR
<300; 3 days; 1 OR bed	1	Surgeon	2	>300; 8 Days; 2 OR beds
	1	CRNA	2	
	1	OR Tech	2	
	1	Medic	2	
	1	RN	2	
Planning Considerations: Security provided by Special Forces Operational Detachment Alpha (ODA) Team; No holding capability; ECSS Class I (H2O), Class III (Fuel), Class VII (Forklift), Class VIII (meds,etc); Movement - Pkg comes w/3 Light All-Terrain Vehicles (LTATVs, custom Polaris Razors), 1 f/patient movement & 2 f/equipment movement; Forklift required for Kick-Box removal on LTATVs				

Figure 7

Despite it being a tactic, technique and procedure (TTP) only, the GHOSTT platform creates an interesting move towards the small scale footprint required for COCOM small Force Management Levels (FMLs) associated for support for SOCOM missions. The term GHOSTT formalizes the Army's split of its FST into a smaller unit. It has been called a Split FST or Flex FST in the past. For now the Army is concentrating on the FRST conversion over the next Future Years Defense Program (FYDP) with annual conversions. Figure 8 below shows the conversion rates for 40 FSTs and six prepositioned equipment sets.

²⁴ Pasek, Gabriella M, USA LTC. "U.S. Army Structure and Health Service Support Capabilities." PowerPoint presentation, Joint Medical Operations Course, 8 Mar 16.

²⁵ Un-Named Speaker. "USASOC Capabilities Brief." Joint Special Operations Medical Orientation Course, Joint Special Operations University, MacDill AFB FL, 13 Mar 17.



* Forward Resuscitative & Surg Team (FRST)					Personnel In Each Element			Capabilities	
	AC	USAR	APS	Total	Admin/- Supply	Surgical	Resuscitative	Emergency Treatment	Post-Op Care for
2018	6	6	1	13					
2019	6	6	4	16					
2020	4	5	1	10					
2021	2	5		7					
TOTAL	18	22	6	46					
					Configuration				
					Admin/- Supply	Surgical	Resuscitative	Emergency Treatment	Post-Op Care for
					0	6 p	0	4 patients over 24 hrs	Limited
					1 p	6 p	3 p	12 patients over 72 hrs	4 over 6 hrs
					2 p	12 p	6 p	30 patients over 72 hrs	8 over 6 hrs

Figure 8²⁶

The Navy

Similar in force structure to the Army, Naval medical personnel are divided into Fleet Forces Command, or FLTFORCOM, for rotational taskings and the Bureau of Medicine, or BUMED, for institutional medicine delivery. Navy deployment allocations are assigned to FLTFORCOM for its present of forces in support of a combatant commander's AOR requirements. The typical Navy deployment length is eight months, or 245 days, with a deployment to dwell goal ratio of 1:2, minimum ratio of 1:1 and a maximum ratio of 540 cumulative days over a rolling three year period consisting of one future year and two past years.²⁷

The Navy's approach to DCS is split between the traditional Navy, or the "Blue Side" and the Marines. The Blue Side DCS is provided by Role 2 Light Maneuver (2LM) units that support land maneuver formations and conduct advanced resuscitation procedures up to DCS with 16 PAX Fleet Surgical Teams (FSTs) to augment their various casualty receiving ships (LHA, LHD and LPD) for afloat surgical needs. According to the 2015 Naval Operational Medicine Capabilities Handbook, there are nine FSTs in service. The FST was established to provide support for peacetime forward presence missions

²⁶ Felthous, John A. (USA LTC). "FRST Draft Conversion Timeline." PowerPoint Presentation, 20 Dec 16.

²⁷ Operational Naval Instruction 3000.13D, Navy Force Generation, 14 Mar 14, Pg. 1, Enc. (2).

and contingency support.²⁸ According to the FST's Authorized Medical Allowance List (AMAL), it can treat 25 surgical cases without resupply. See Figure 9 below for a complete breakdown of location and manpower.

Navy Fleet Surgical Team (FST - 16 PAX)		
Units	PAX TYPE	PAX
FST #1 San Diego, PHIBRON 3	OIC/CATF Surgeon	1
FST #2 Norfolk, PHIBRON 2	General Surgeon	1
FST #3 San Diego, PHIBRON 3	Anesthetist/CRNA	1
FST #4 Norfolk, PHIBRON 2	FP/IM/ER/PED	1
FST #5 San Diego, PHIBRON 3	Perioperative Nurse	1
FST #6 Norfolk, PHIBRON 2	ICU/ERC Nurse	1
FST #7 Okinawa, PHIBRON 1	Medical Regulator//Admin	1
FST #8 Norfolk, PHIBRON 2	LCPO	1
FST #9 San Diego, PHIBRON 3	OR Tech	2
	Advance Lab Tech	2
	Respiratory Therapy Tech	1
	General Duty HM	2
	Radiology Tech	1

Figure 9

To keep up with the changing landscape of DCS, the Navy is currently working on an Expeditionary Resuscitative Surgical System (ERSS) to provide advanced, modular, mission-specific capability close to POI for afloat and ashore surgical, trauma and enroute care.²⁹ This system is comprised of an Expeditionary Surgical Team (EST), an Expeditionary Trauma Team (ETT) and an En Route Care Team (ERCT). The EST will provide forward initial resuscitative surgery via a 5 PAX team and can handle 5 DCSs with patient holding for two to four hours. Figure 10 below shows the complete ERSS breakdown.

Navy Expeditionary Resuscitative Surgical System (ERSS)		
Navy Expeditionary Surgical Team (EST - 5 PAX)		
MSN	PAX TYPE	PAX
45-min set-up time; 5 DCSs; Holds 2-4 hrs	General Surgeon	1
	Anesthetist/CRNA	1
	Critical Care Nurse	1
	OR Tech	2
Expeditionary Trauma Team (ETT - 2 PAX)		
MSN	PAX TYPE	PAX
small platform based; life-and-limb saving	ER Doc	1
	IDC	1
En Route Care Team (ERCT - 2 PAX)		
MSN	PAX TYPE	PAX
Osprey movement care only; manages 2 stabilized pax for 2-hr transits	ER Doc	1
	IDC	1

Figure 10

The Marines

²⁸ Unknown Author. "Naval Operational Medicine Capabilities Handbook". Department of the Navy, Bureau of Medicine and Surgery, 2015 Edition.

²⁹ *Ibid*, 28.

For Marine Expeditionary Forces (MEF) DCS, the Navy Bureau of Medicine supports their medical needs with the Medical Battalion (MED BN), Marine Logistics Group (MLG). The MED BN, MLG mission is to provide direct and general Health Service Support (HSS) Role 2 care for initial resuscitative care, resuscitative surgery and temporary holding of casualties.³⁰ There are four MED BNs: Marine Forces Pacific (MARFORPAC) has the 1st and 3d MED BN; Marine Force Command (MARFORCOM) has the 2d MED BN; and Marine Forces Reserves (MARFORRES) has the 4th MED BN. The MED BNs are further broken down into Health & Service Companies (H&SCo's) and two to three Surgical Companies (SC). Each H&SCo is composed of a staff section and 2 surgical platoons and each SC is composed of a H&S Platoon (H&SP) and three to four Surgical Platoons (SP). Each SP is composed of a Shock Trauma Platoon (STP) and a Forward Resuscitative Surgery System (FRSS). STPs function as a casualty receiving point and provide limited resuscitative and stabilization treatment for movement of casualties. The FRSS is a mobile, rapidly deployable trauma surgical unit for emergency surgical interventions required to stabilize casualties who might otherwise die or lose limbs or eyesight before receiving appropriate treatment.³¹ The FRSS is designed to be attached to an STP. The Marines have a total of 32 FRSSs: 14 at 1st MED BN, 10 at 2d MED BN and eight at MED BN. Numbers attached to MARFORRES were not discussed in the Navy Capabilities Handbook. The FRSS is capable of 18 DCS patients without resupply.

The Air Force

Unlike the Army and the Navy, Air Force (AF) medical personnel are not divided between rotational and institutional force commands. Instead the Air Force denotes its deployment capable forces through posture coding of its personnel assigned to unit type codes. This act somewhat complicates presentation of forces in support of a combatant commander's AOR requirements. To compensate the AF uses the teaming concept of unit type codes to support air operations requiring medical capability predicated on base operational support (BOS). Typical medical deployments for the AF are at a 1:3 (six months deployed and 18 months home) deploy to dwell ratio over a 24 month schedule.³²

The Air Force employs DCS through the Mobile Field Surgical Team (MFST), now called the Ground Surgical Team (GST), for conventional taskings and the Special Operations Surgical Team (SOST) for unconventional taskings:

³⁰ Unknown Author. "Naval Operational Medicine Capabilities Handbook." Department of the Navy, Bureau of Medicine and Surgery, 2015 Edition.

³¹ *Ibid*, 30.

³² Air Force Policy Directive 10-4, *Air Force Generation*, 30 Apr 09, Pgs. 5 & 6.

The MFST is the ground medical manpower compliment to the EMEDS building block design mentioned earlier. Figure 8 shows the manpower layout for the MFST. The MFST is capable of 10 DCSs without resupply. The MFST concept is evolving into the Ground Surgical Team to accommodate the COCOM's requirement for austere surgery capability in support of ground combat operations. There is a slight change to personnel and equipment sets when moving from the MFST platform to the GST platform. See Figure 11 for the manpower change. There are currently 54 GSTs in the Air Force inventory spread out amongst Pacific Air Forces, U.S. Air Forces Europe and the component Service.³³

Mobile Field Surgical Team (MFST - 5 PAX)		
MSN	PAX TYPE	PAX
Provides resuscitative trauma surgery for 10 DCS cases based on supply; zero patient holding	General Surgeon	1
	Ortho Surgeon*	1
	Anesthesiologist	1
	ER Doc	1
	OR Tech	1
Ground Surgical Team (GST - 6 PAX)		
MSN	PAX TYPE	PAX
Provides resuscitative trauma surgery for 4-6 DCS cases; patient holding for 12 hrs	General Surgeon	1
	Anesthesiologist	1
	ER Doc	1
	Critical Care Nurse*	1
	OR Tech	1
	Medical Svs Corps	1
* Surgery capability is sacrificed for holding capacity in the new GST model		

Figure 11

The MFST/Enhanced Critical Care Team (ECCT) is a hybrid variant for short term engagements in the Middle Eastern AOR. It incorporates manpower and equipment from the MFST and adds patient holding capability. This team was created out of necessity due to the limited number of MFSTs available for tasking and the growing need for ground surgery support. There is only one formally designed team in operation today and is supported rotationally with personnel from the MFST.

The SOST is the Air Force's answer for support to the SOCOM medical requirements for DCS. The mission of the SOST is to provide resuscitative surgery and advanced trauma life support coupled with partner capacity of the Special Operations Critical Care Evacuation Team (SOCCET) for critical care or casualty management of four stabilized patients (post-trauma/operative) aboard opportune evacuation

³³ Unknown Author. "How the Air Force Deploys." PowerPoint Presentation (short version). Headquarters Air Combat Command, Office of the Command Surgeon, 4 May 17.

platforms.³⁴ There are 6 SOST units: three at the University of Alabama, Birmingham; one at University Medical Center, Las Vegas; and two at Ryder Trauma Center, Miami. Placement of the teams at civilian institutions was necessary due to the small scope and scale of AFSOC military treatment facilities and lack of surgical currency availability at those locations due to the predominantly healthy military workforce. Figure 12 below depicts the SOST structure.

AFSOC Special Operations Surgical Team (SOST - 6 PAX)		
MSN	PAX TYPE	PAX
Resuscitative surgery & advanced trauma life support; Critical care/casualty management of 4 stabilized patients (post trauma/operative) aboard opportune evac platforms	General Surgeon	1
	Emergency Physician	1
	Anesthesiologist	1
	Critical Care Nurse	1
	Cardiopulmonary Tech	1
	Operating Room Tech	1

Figure 12

Summary

To quickly recap the above, each Service is structured slightly different than the other with additional deployment length differences. Over the years each Service has modified their deployment schedules after major wars to adjust for the expansion and shrinking of personnel strength numbers. Circling back to the topic of DCS, a quick look was provided to show how each Service provides DCS to help set the foundation of how DCS could evolve as the MHS faces current and future challenges for the delivery of operational medicine.

V. COURSES OF ACTION

On 18 April 2017 a meeting, comprised of Joint Staff representatives, Service branch medical readiness planners and leadership, took place in Norfolk, VA to discuss COCOM DCS requirements. The outcome was a shared perspective amongst the Services that there is a clear deficit of DCS capability in the MHS compared to the validated taskings coming from Joint Staff to the Service components to fill. The Joint Staff was asked to go back to the COCOMs with the direction to seriously look at their DCS requirements for stratification and validity in an effort to minimize asking for capability from an already exhausted inventory of surgery teams.

³⁴ Harvis, Lee, USAF Colonel. "AFSOC [Medical] Operational Capabilities." PowerPoint Presentation, Joint Special Operations Medical Orientation Course, Joint Special Operations University, MacDill AFB FL, 13 March 17.

As the demand signal for DCS in austere locations or environments grow, the Services must come to an understanding and agreement on the direction of support for COCOM requirements regardless of the number of taskings from Joint Staff. The time for parochialism is dead when providing support for SOCOM, or is it? SOCOM does not have enough DCS capability for multiple engagements in multiple theaters of the globe, and the respective Services have not fully developed enough DCS capability to support SOCOM while simultaneously fulfilling previously vetted rotational requirements. A person can only be in one place at a time. Knowing what each Service brings to the fight for DCS and current projects to expand austere DCS capability, do we stay in our own lanes, or do we venture into the “purple”? The following Courses of Action (COAs) are offered as potential solutions to the DCS debate:

COA #1 - Do nothing; small footprint DCS is a SOCOM requirement and should be taken care of by SOCOM assets.

Discussion-

SOCOM gets its own separate MFP-11 (Major Force Program) dollars to develop SOF specific capabilities. If the command needs more surgical teams to fulfill requirements, it should POM (Programming Objective Memorandum – budget lists) for more money to bolster personnel, equipment and supply to get the job done. Since the SOST is an already established answer to the DCS needs of the COCOM, asking for more money is easy. However, the SOST’s manpower and equipment is POM’d through the AF component level and could complicate normal funding lines. This is a bit of conflict of interest if Big AF does not yet see the SOST as the answer, and therefore has not projected more money or avenues to address the problem.

Finally, the SOST platform could be redirected back to SOCOM’s budget since it has retained its SOF-like need and capability. The Air Force has its own surgery requirement to fill at the EMEDS level of deployed medical care delivery.

COA #2 - Continue current efforts; further explore, develop and deepen Service specific DCS capability sets to satisfy small engagement scenarios at an on-call rate for CONUS/OCONUS requirements.

Discussion-

The AF, Army and Navy either have or already developed the capability to break off pieces of their Service component’s surgery capability to serve SOCOM requirements while deployed in theater. Further developing interservice training opportunities will ensure interoperability of the surgical teams when paired to other Services as the surgery provider. Additionally, infusing formal rotary and fixed

wing aeromedical evacuation training into Service schools will further increase fly-away capability if/when needed. Finally, to capitalize on the bolstered training, COCOMs would need to establish formal training policies and procedures to enhance partner training with sister Services when deployed to maximize DCS leverage capability on the battlefield or underway at sea.

COA #3 - Create a Joint DCS Team (JDCST) capability pulling attributes from each Service to provide comprehensive surgical capability for all small contingency planning scenarios.

Discussion-

The JDCST concept satisfies NDAA direction for Joint effort and the requirement to establish a Joint Trauma Training and Education Directorate. The directorate would then create a 12-month Joint Trauma Training Curriculum comprised of flagship Service schools for trauma and surgery training. Each school program would consist of two parts: a didactic portion followed by an applied exercise for each Service's unique requirements for delivery of care and transport and evacuation platforms. The final portion of the Joint curriculum would be a capstone Joint national level exercise in which the JDCST would be comprised of members from each Service and be tested against curriculum criteria. The success of this option depends upon congressional support for DHA to program, budget and develop the shared service capability, the agreement of a Joint curriculum with exercises, and the all-in/buy-in from each Service for the necessary mission essential tasks (METs) and Master Sequence of Events Listing (MSEL) for verification/validation.

Next, the Joint Staff (J3-5) will need to establish a Joint Force Module within the Joint Capabilities Requirements Manager (JCRM) and the Joint Operational Planning and Execution System (JOPES). Each Service will be required to establish their own set of individual Unit Type Codes (UTCs) for each position on the JDCST within their own system of record and in the Type Unit Characteristic (TUCHA) file of the JOPES enterprise. Therefore, each manpower UTC position will be created for the following personnel: General Surgeon, Anesthesiologist/CRNA, ER Physician, Critical Care Nurse, OR Technician/Specialist and Medical Admin Officer. Then a Special Experience Identifier (SEI) will be created and used to identify all JDCST qualified individuals.

Lastly, a JDCST Equipment List will need to be created with buy-in from the Services and procured and updated by DHA Logistics Shared Service Dept. through prime vendor contracts. The equipment will be maintained by a DHA lead for main storage and distribution with extra prepositioned sets given to each Geographic COCOM to ease employment and redeployment actions of the team. Utilization of the JDCST is governed by the SECDEF and JCS, with input from DHA and Service components, by dividing the total number JDCSTs amongst COCOMs for planning requirements. This action will eliminate

arguments between components and COCOMs during planning emergent and contingency scenarios. If new teams are formed after the fact, the SECDEF will approve and distribute as described above.

Course of Action Comparison

Criteria for Course of Action Selection								
	Provides Service Latitude	Enhances Future Planning	Risk to Force	Risk to Mission	Effective Manpower Use	Cost Effective	Flexibility	SCORES
COA 1	1	1	1	3	3	3	1	13
COA 2	3	2	3	2	2	2	3	17
COA 3	2	3	2	1	1	1	2	12
Ratings: 1 - Least Desirable; 2 - Moderately Desirable; 3 - Most Desirable								
COA #1 - Do nothing; small footprint DCS is a SOCOM requirement and should be taken care of by SOCOM assets.								
COA #2 - Continue current efforts; Further explore, develop and deepen service specific DCS capability sets to satisfy small engagement scenarios at an on-call rate for CONUS/OCNUS requirements.								
COA #3 - Create a Joint DCS Team (JDCST) capability pulling attributes from each service to provide comprehensive surgical capability for all small contingency planning scenarios.								
Criteria:								
Provides Service Latitude - Do the services retain control over training and utilization, and/or do the services have the ability to shape the DCS capability?								
Enhances Future Planning - How well does this COA benefit COCOMs when planning for future operations?								
Risk to Force - Does this COA place the component force at risk from the service level perspective in not being able to meet service delivery of healthcare to the institutional force CONUS and/or OCONUS?								
Risk to Mission - Does this COA effect the service component's ability to properly plan at the mission level?								
Effective Use of Manpower - Does this COA provide for the effective use of service level DCS manpower?								
Cost Effective - Is this COA cost effective both now and in the future; is it sustainable?								
Flexibility - Does this COA provide COCOMs the necessary flexibility to meet the needs of the AOR?								

Figure 13

Figure 13 above numerically grades each COA against a list of criteria. The questions were general in nature and not meant to favor one COA over another. Honestly, COA #3 was expected to win over the other two given its Joint capabilities and planning factors, but when it came down to how the COAs affected the Service components abilities, it ranked last. This is a fundamental issue as all Joint endeavors and solutions agreed to or conferred upon the separate Services have to be filled by those Services at the end of the day. Since each Service has different ways to program, we are truly hampered to be Joint.

The Right Choice

First, a few conditions need to be discussed. Can the Services be interchangeable or are they interoperable, at best? The term interchangeable, as defined by Dictionary.com, means “(of two things) capable of being put or used in the place of each other [as in interchangeable symbols], or (of one thing) capable of replacing or changing places with something else [as in an interchangeable part].” The term interoperable, as defined by Dictionary.com, means “capable of being used or operated reciprocally [as in

an interoperable weapons system], or the ability of software and hardware on multiple machines from multiple vendors to communicate.” Therefore, based upon the definitions, the debate is whether a medical surgeon is replaceable with another medical surgeon from a sister military branch, or the medical surgeon is able to work within the sister Service medical system under a given set of circumstances.

In order to leverage the medical surgeon through force interchangeability, each Service’s training aspects have to be congruent enough to warrant the switch, as well as having the same deployment lengths to effectively task coinciding requests for forces. Below are examples of how different Service deployment training requirements can be:

Army Surgical Training Example³⁵:

Brigade Combat Team Trauma Training (BCT3) Course
Tactical Combat Medical Care (TCMC) Course
Joint Forces Combat Trauma Management Course (JFCTMC)

AF Surgical Training Example³⁶:

AF Expeditionary Medical Support (EMEDS) Course
Centers for Sustainment of Trauma and Readiness Skills (C-STARS)
Emergency Wartime Surgery Course (EWSC)

Navy Surgical Training Example³⁷:

Casualty Combat Care Course (C4)
Trauma Combat Casualty Care (TCCC)
Advance Trauma Life Support (ATLS) and Advanced Cardiovascular Life Support (ACLS)
Joint Enroute Care Course (JECC)
Navy Trauma Training Center (NTTC)
Emergency Wartime Surgery Course (EWSC)
Concussion/Mild Traumatic Brain Injury (mTBI) in the Deployed Setting
Military Acute Concussion Evaluation (MACE)/CPG/DoDI Course
Combat Extremity Surgery Course (CESC)
Advanced Burn Life Support (ABLS)

Considering the aforementioned deployment length differences and the above training examples, the idea of interchangeability is seemingly out of reach during present force apportionment and allocation. But what of the interoperability concept?

Leveraging the medical surgeon through force interoperability requires joint training practices for familiarization with each Service’s equipment configurations and training guidelines. Each Service’s medical personnel are able, with some degree of timing difficulty based on deployment taskings and lengths, to attend each other’s respective training courses. This joint-effort training has already occurred for some nonstandard missions as a result of “go dos” from senior medical leadership. A few examples

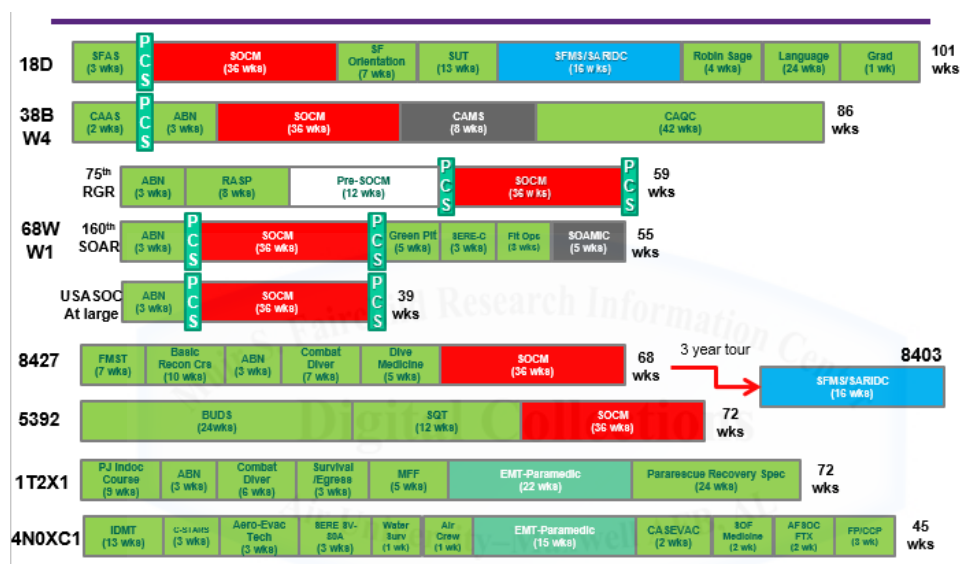
³⁵ Cooper, Jimmy, LTC (Dr.), “Center for Pre-deployment Training prepares medical professionals for trauma.” AMEDDC&S Newsletter. Vol 2, Iss. 2. April/May 2013. Pgs. 1-2.

³⁶ Air Force Instruction 41-106, *Medical Readiness Program Management*, 22 Apr 14, Paras 5.4.2., 5.4.8.-5.4.8.1. & 5.4.8.2.4.

³⁷ Bureau of Medicine Note 1500, BUMED-M7, 14 Jan 16.

of interservice training are: 1) The deployment of a Naval DCS Team, trained by the Army and using AF equipment, deployed to the AFRICOM AOR; and 2) The short term backfill of an off-shore Naval surgery team by an AF surgery team. The respective Services will continue to meet combatant commander requirements, but at some point, each Service's budget and programming practices will have to marry up with evolving changes in medical support requirements and inherent level of acceptable risk on the part of the combatant commander for loss of life.

Can training be the linchpin to ensure both interoperability and interchangeability? Figure 14 below shows the notional training timelines for enlisted medical technicians and independent duty technician Service specialties.



18D - Special Forces Medical Sergeant; 38BW4 - Civil Affairs Specialist SOF Medic; 68WW1 - Healthcare Specialist Combat Medic with SOCM
 8427 - Marine Force Recon Corpsman; 8403 - Special Operations Independent Duty Corpsman; 5392 - Special Operations Combat Medic (SEAL)
 1T2X1 - Parachute/Jump Rescue (PJ); 4N0XC1 - Independent Duty Medical Technician

Figure 14³⁸

Why is the above information significant? It shows the incredible amount of time invested into individuals able to provide unsupervised medical care in the field environment. If this level of training is provided to our numerous enlisted folks (roughly 6,500 4N0XC1s and 620 IDMTs on the AF side alone), then why not provide the same level of training to our surgeons and other providers, considering there are roughly 200 surgeons in the entire MHS? If the answer is “Because military medics must care for the family members of the active duty population”, then perhaps a reassessment of the existential reason for military medics may be in order. Remember, the military is one of four instruments of power wielded by the U.S. to influence change in our allies and enemies. The medical departments of each Service exist to

³⁸ Combat Medic Training Timeline. Lecture and PowerPoint Presentation, Joint Special Operations Medical Orientation Course. Joint Special Operations University, MacDill AFB FL, January 2017.

ensure a healthy warfighter and instill confidence in that warfighter to perform at the highest level knowing there will be a trained medic to support him or her.

Interchangeability and interoperability do have different meanings when applied to the deployment of personnel from more than one Service. A planner cannot interchange other Service's personnel due to the different deployment timeframes unless the individual Services agree to a standard length of deployment for DCS teams under COA #3. A planner will definitely be faced with interoperability challenges given the different training requirements and associated Service specific equipment used for deployment, versus COA #3's call for standardized DCS equipment. However, COA #3 was numerically the least desirable COA. COA #2 won out numerically. However, COA #3 also shares a common training theme. MHS leaders agree on the necessity of Joint exercises and that the key is to develop a joint small-footprint, agile solution to DCS that can be unilaterally applied and used when planning future medical operations in a joint environment.³⁹ Given the extensive papers, articles, news stories and lessons-learned from Joint exercises, are the Services' priorities aligned to the Joint requirements?

SOCOM has submitted DCS as one of its top five priorities on its Integrated Priorities List (IPL). This list is reviewed regularly by the JCS, who then directs the Services to program for more capacity or to develop new capability to meet the COCOM's needs. As the institutional service provider for SOCOM, AFSOC's medical SG priorities are aligned accordingly and embrace the joint mentality:

- 1) Ensure Readiness - Demand Signal for Surgical Teams; Comprehensive Readiness Trauma Platforms; Austere Surgical Updates
- 2) Adapt to Multi-Domain and Cross-functional operations - AFSOC Current Medical Operations; Modernization
- 3) Expand and Enhance Relationships - Partnership with MEDCOM and BUMED; Expansion of SOST to AFRC IMAs

These priorities point directly to the assigned and apportioned forces in SOCOM. The institutional Service components also embrace the joint concept, but in a different way. The Service components combine separately to fulfill their Service's mission in a synergistic Joint environment to create, or exact, military effects. This fundamental directly points back to interchangeability and interoperability principles. Are there other conditions to explore that adversely affect COA decision?

War has demonstrated the value of getting patients the right care, at the right time and at the right place.⁴⁰ Timely medical care, coupled with the advent of aeromedical evacuation from the Korean and Vietnam Wars, has fundamentally changed⁴¹, or evolved, current medical doctrine from the World Wars

³⁹ Cronk, Terri Moon. "Joint Medical Exercise Trains for Future Interoperability." DoD News, Defense Media Activity. Accessed from: <http://www.defense.gov/News/Article/Article/612622> on 11 Nov 16.

⁴⁰ Cosgrove, Delos M. "Medical Lessons from the Vietnam War." Cleveland Clinic Health Essentials, 15 Jan 14. Accessed on 10 Feb 17 from: <https://health.clevelandclinic.org/2014/01/medical-lessons-from-the-vietnam-war/>

⁴¹ Howard, Major William G. "History of Aeromedical Evacuation in the Korean War and Vietnam War." U.S.A ACSC White Paper via Edinboro University, Pennsylvania, 1991. Accessed on 17 Apr 17 from: <http://www.dtic.mil/dtic/tr/fulltext/u2/a416927.pdf>

in such a way that in today's direct action scenarios, there is little to improve upon conceptually. The MODE concepts of A2/AD and CODE challenge healthcare, but only in the environment of care, casualty movement and supply chain realms and not in the aspect of care delivery (or actual DCS). So, what COA blends the best of all the above discussed topics?

COA #2 is recommended with the Joint Training Curriculum discussed for COA #3. COA #2 not only wins numerically as depicted in the comparison chart (Figure 10) but, more importantly, allows each Service to leverage their own capabilities to support their institutional forces while enhancing their ability to break-out small teams to meet individual COCOM needs when deployed. Embracing Joint training and exercises will enhance each Service's unique attributes and enable joint partnership when called for by special mission parameters, such as those carried out by SOCOM.

VI. CONCLUSION

In conclusion, DCS needs to be planned for in a joint manner with buy-in and participation from each Service in order to maximize the availability of DCS for theater specific requirements within the area of operation. Through discussion of the aspects of interoperability and interchangeability, how each Service OT&Es their personnel, and each Service's DCS capabilities, 3 COAs were presented in an effort to address common issues faced with Joint planning and execution. While each COA provided some measure of Service-level success, only COAs #2 and #3 provided a potential Joint answer to the problem of DCS. In the end, the recommendation of COA #2 with the addition of the Joint Trauma Training Curriculum proposed in COA #3 appears to be the most viable and executable strategy to meet validated DCS requirements. In thinking jointly, medical leaders and planners should remember that all Joint taskings will eventually be filled at the individual Service level. Therefore, planners directly involved with doctrinal changes and problem solving strategies should keep the principles, information and ideas represented in this paper at the forefront of their mind to effectively plan for rotational and emergent scenarios both now and in the future years to leverage DCS capabilities in the Joint environment.

APPENDIX A

World War I (July 28, 1914 – November 11, 1918)

The United States entered the war in 1917 and in less than a year suffered more than 318,000 casualties, of which 120,000 were deaths.⁴² At the time, the Army did not have an established medical corps. The medical draft was instituted to quickly increase capability and the Army mirrored major parts of the French and English in-place battlefield medical systems.⁴³ The system was arranged in a tiered approach with stretcher-bearers at point of injury (POI) to move the wounded from the trenches to waiting ambulances who would then take them to mobile dressing stations or field hospitals for higher level care and then onward movement by ambulance or trains to base hospitals far behind the lines.⁴⁴ At the end of 1918, there were 134 American hospitals totaling 163,368 beds in France, spread out amongst among 22 hospital systems located 50 to 200 miles from the frontlines.⁴⁵

World War I saw the first use of poisonous gases as deadly weapons.^{46,47} The gases burned skin and irritated mucosal linings causing death or paralysis by asphyxiation within minutes of exposure.⁴⁸ When gas warfare began, French Senegalese troops discovered that urine soaked cloth held over the nose and mouth protected soldiers from the acute effects of chlorine gas, paving the way for gas masks made with similar chemicals similar to urea to counteract chlorine gas.⁴⁹ The use of gas masks helped with some prevention, but exposed clothing kept the gases closer to the body and infiltrated wounds of the injured, complicating care received during patient movement. However, not all injuries were physical.

The poor, unhygienic field conditions along with mental-cognitive effects of multiple exploding shells exacerbated war wounds and caused additional health problems for the medical system to treat, for example: rats, rotting corpses, shell shock, trench foot, influenza, intestinal flu, tetanus and gas gangrene.^{50,51,52} Although Civil War medicine is not discussed in this paper, military medicine remained unchanged leading into World War I, and doctors failed to make a connection to the environmental factors that affected surgery and healing until later in the war. Once recognized, the wounded were operated on as quickly as possible, preferably within twelve hours, to prevent higher risk for infection.⁵³

During surgical cases, there was only salt water, carbolic lotion or dakin solution for wound rinsing and debridement by removal of tissue around the wound followed by sealing with bismuth iodiform paraffin paste since no antibiotic medications were available to stop infections once they had begun.^{54,55,56} Examples of other frequently used medications were: cocaine hydrochloric, as a local anesthetic, and chloroform, as both a general anesthetic in surgeries and a sedative; for pain, common analgesics were sodium salicylate, opium elixir, and morphine sulfate.⁵⁷

⁴² Campbell, John. "WWI: Medicine on the Battlefield." Tar Heel Junior Historian Association, 1993, via NC Museum of History. Accessed on 8 Feb 17 from: <http://www.ncpedia.org/wwi-medicine-battlefield>

⁴³ *Ibid*, 42.

⁴⁴ *Ibid*, 42.

⁴⁵ Unknown Author. "Setting Up Base Hospital#28 in France." KU Medical Center. Accessed on 8 Feb 17 from: <http://www.kumc.edu/wwi/base-hospital-28/setting-up-in-france.html>

⁴⁶ *Ibid*, 42.

⁴⁷ Brosnan, Matt. "A Short Guide To Medical Services During The First World War." Imperial War Museums. Accessed on 8 Feb 17 from: <http://www.iwm.org.uk/history/a-short-guide-to-medical-services-during-the-first-world-war>

⁴⁸ *Ibid*, 42.

⁴⁹ *Ibid*, 45.

⁵⁰ *Ibid*, 42.

⁵¹ *Ibid*, 47.

⁵² *Ibid*, 45.

⁵³ *Ibid*, 42.

⁵⁴ *Ibid*, 42.

⁵⁵ Anderson, Julie. "Wounding in War One." British Library Newsletter. Accessed on 8 Feb 17 from: <https://www.bl.uk/world-war-one/articles/wounding-in-world-war-one>

⁵⁶ Unknown Author. "Nursing and Medicine During World War I." CEUfast Nursing CE Blog, 31 Dec 13. Accessed on 8 Feb 17 from: <https://ceufast.com/blog/nursing-and-medicine-during-world-war-i>

⁵⁷ *Ibid*, 55.

Amputations were frequent due to the limited medical capabilities of the time and also served as a means to control infection along with delayed closure in treating contaminated war wounds.^{58,59} Surgeons and doctors were forced to find new methods to treat severe cases of tissue damage, burns, and contagious diseases.⁶⁰ On a positive note, blood transfusions were now being given in battlefield conditions and x-ray machines were used for bullet and shrapnel location during surgical cases.⁶¹ For the first time, the practice of medicine was beginning to advance forward.

The example below is Base Hospital #28 from WWI. Set-up time was roughly three months in duration before a census of 2,343 patients was determined. In its final report, Base Hospital #28 collected the following statistics: “The total number of patients admitted was 9,954. Of these 6,087 (61%) were medical cases and 3,867 (39%) were surgical cases. Of the total number of cases, 4,321 (43%) were returned to their units while the remainder were either evacuated home or died. Stratification of treated wounds by location showed 17% to be of upper extremities, 46% lower extremities, 16% head and neck, 3% of the abdomen and genitals, 6% of the back and side, 4% of the chest, and 6% were of multiple wounds.”⁶²



Base Hospital #28 Timeline⁶³

Figure 15

⁵⁸ Campbell, John. “WWI: Medicine on the Battlefield.” Tar Heel Junior Historian Association, 1993, via NC Museum of History. Accessed on 8 Feb 17 from: <http://www.ncpedia.org/wwi-medicine-battlefield>

⁵⁹ Stepansky, Paul E. “An Irony of War.” Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

⁶⁰ *Ibid*, 58.

⁶¹ Unknown Author. “Medicine in the War Zone.” Science Museum. Accessed on 8 Feb 17 from: <http://www.sciencemuseum.org.uk/broughttolife/themes/war/warzone>

⁶² Unknown Author. “Setting Up Base Hospital#28 in France.” KU Medical Center. Accessed on 8 Feb 17 from: <http://www.kumc.edu/wwi/base-hospital-28/setting-up-in-france.html>

⁶³ *Ibid*, 62.

APPENDIX B

World War II (September 1, 1939 – September 2, 1945)

“If any good can be said to come of war, then the Second War must go on record as assisting and accelerating one of the greatest blessings that the 20th Century has conferred on Man – the huge advances in medical knowledge and surgical techniques. War, by producing so many and such appalling casualties, and by creating such widespread conditions in which disease can flourish, confronted the medical profession with an enormous challenge – and the doctors of the world rose to the challenge of the last war magnificently.” -Brian J. Ford⁶⁴

As alluded to in the quote above, advances in medical care from World War I were further improved upon during the second war. Surgical facilities were positioned far forward closer to the front line and transport was by motor vehicle. Having vehicle capability meant that the majority of the severely wounded could be operated on within 12 hours in keeping with the first war protocols.^{65,66} In permissive environments planes were beginning to be used to transport the severely wounded to hospitals for further surgical care. This change was first brought about and attributed to data gathered by the French during the first war. The concept of the ‘golden hour’, that patient treatment within 60 minutes of multiple trauma would drastically improve mortality and outcomes, was introduced into the medical sight picture and planning efforts.⁶⁷

Additional frontline capability was added through the standardization of blood transfusions as the advent of the Army Blood Transfusion Service came about, providing expertise and shipments of blood across the multiple battlefronts and geographic regions of the global battlespace.^{68,69} Other medical advances were seen in medication development with the mass-producing of Penicillin and sulfonamides to prevent and treat infection; psychosomatic medications for shell-shock; diseases were quelled with DDT dusting over large areas to reduce malaria, typhus, and vector-borne illness; and the further forward surgery capability also meant that specialty care by way of craniofacial, neuro, plastic ophthalmic and hand surgeries and burn treatment could be staged closer as well.^{70,71,72,73} The use of chemical warfare in the second war continued as well. However, huge success came in the development of the gas mask and its carbon filters that could absorb the poison gases used by the enemy.⁷⁴ Casualty survival in WWII relied heavily on proximity to care, with wounded servicemen in the Pacific having a decreased chance of survival from the rugged, isolated terrain. Soldiers who received care within the established golden hour timeline typically had a 90% chance of survival while those that received care after eight hours saw a survivability rate drop to 25%, meaning that rapid movement to advanced care considerably increased survivability rates.⁷⁵ The availability and portability of the front line surgical hospitals augmented the survivability rates by providing emergency surgery and stabilization for movement to the next higher echelon of care. As an early example, during the 3d Portable Surgical Hospital’s first forward week, 67 major surgical procedures were

⁶⁴ Trueman, C. N. “Medicine and World War Two.” The History Learning Site, 6 Mar 15. Accessed on 9 Feb 17 from: <http://www.historylearningsite.co.uk/world-war-two/medicine-and-world-war-two/>

⁶⁵ Brosnan, Matt. “A Quick Guide To Medical Services In The Second World War.” Imperial War Museums. Accessed on 8 Feb 17 from: <http://www.iwm.org.uk/history/a-quick-guide-to-medical-services-in-the-second-world-war>

⁶⁶ Unknown Author. “Medicine in the War Zone.” Science Museum. Accessed on 8 Feb 17 from: <http://www.sciencemuseum.org.uk/broughttolife/themes/war/warzone>

⁶⁷ *Ibid*, 66.

⁶⁸ *Ibid*, 65.

⁶⁹ *Ibid*, 64.

⁷⁰ *Ibid*, 65.

⁷¹ *Ibid*, 64.

⁷² Stepansky, Paul E. “An Irony of War.” Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

⁷³ Stepansky, Paul E. “Medicine, Health, and History.” Blog at WordPress.com, 5 Jul 14. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

⁷⁴ *Ibid*, 64.

⁷⁵ Diamond, Jon. “World War 2 Casualties & Caring for the Wounded.” Warfare History Network, 3 Jan 16. Accessed on 9 Feb 17 from: <http://warfarehistorynetwork.com/daily/wwii/world-war-2-casualties-caring-for-the-wounded/>

performed, including amputations, bowel resections, and other operations that would otherwise challenge an urban metropolitan hospital's capabilities.⁷⁶ Allied surgeons working in more remote areas, such as Burma, developed alternative treatment methods suited to the jungle environment by wounding typically seen during WWI. Wounds were left open with excision of damaged muscle and bone followed by an occlusive medicated dressing. Wound closure did not occur until 10 days to ensure there were no signs of infection.⁷⁷ It wasn't until WWII that the enemy killed more American troops compared to disease non-battle injury (DNBI): 30% of those wounded in action died; for most campaigns, for every American soldier killed, four or five were wounded; of these, one would be seriously wounded no longer fit for combat, while another would have serious wounds taken care of to such a good extent a return to duty was granted.⁷⁸

As mentioned earlier, the wounded were quickly transferred to higher echelons of care. Medical units that functioned well in WWI were converted or altered to fit the needs of WWII, while others were disbanded for poor performance. The smaller mobile field surgical and evacuation hospitals became the main throughput during WWII. This paved the way for the formal Echelon system along with the need for enhanced command and control to ensure proper patient flow through the various layers of care. The chain of casualty evacuation was built around five distinct echelons, starting at the unit level and ending in stateside evacuation if necessary.^{79,80} Each echelon does only as much as necessary, either to return the casualty to duty or to safely evacuate the casualty to the next higher echelon.^{81,82} The below figure depicts the five Echelons of care and associated medical doctrinal planning rules.

Echelon	Facility	Brought By	Responsibility
Echelon I	Aid Station / Unit Dispensary	Walking, manual transport or litter, ambulance or other vehicles	Unit medical personnel
Echelon II	Collecting Stations to Clearing Stations	Walking, manual transport or litter, ambulance or other vehicles	Medical Battalions, Squadrons or Regiments, Collecting, Ambulance and Clearing elements
Echelon III	Mobile Hospitals: Evacuation, Surgical, Convalescent	Ambulance, Rail, Airplane	Army Medical Service or Independent Corps Medical Service
Echelon IV	General Hospitals, Hospital Centers, Station Hospitals	Rail, Water Transport, Airplane, Ambulance	Medical Service of the Theater of Operations
Echelon V	Hospitals in the Zone of the Interior (ZI)	Rail, Water Transport, Airplane, Ambulance	Medical Service of the GHQ or ZI

Doctrine of Medical Treatment in World War II

Figure 16

"Governing all WW II medical planning were a series of general doctrinal rules, most of which remained valid long after 1945:

1. Commanders of all echelons are responsible for the provision of adequate and proper medical care for all noneffectives [persons whose medical condition prevents them from performing their military duties] of their command;
2. Medical service is continuous;
3. Sick or injured individuals go no farther to the rear than their condition or the medical situation warrants;
4. Sorting of the fit from the unfit takes place at each medical installation in the chain of evacuation;
5. Casualties in the combat zone are collected at medical installations along the general axis of advance of the units to which they pertain;
6. Medical units must possess and retain tactical mobility to permit them to move to positions on the battlefield and enable them to move in support of combat elements;
7. Mobility of medical installations in the combat zone is dependent upon prompt and continuous evacuation by higher medical echelons;
8. The size of medical installations increases and the necessity and ability to move decreases the farther from the front lines these units are located;
9. Medical units must be disposed so as to render the greatest service to the greatest number."

⁷⁶ Diamond, Jon. "World War 2 Casualties & Caring for the Wounded." Warfare History Network, 3 Jan 16.

Accessed on 9 Feb 17 from: <http://warfarehistorynetwork.com/daily/wwii/world-war-2-casualties-caring-for-the-wounded/>

⁷⁷ *Ibid*, 76.

⁷⁸ *Ibid*, 76.

⁷⁹ Unknown Author. "WW II Medical Treatment." Olive-Drab.com. Accessed on 9 Feb 17 from: http://olive-drab.com/od_medical_treatment_ww2.php

⁸⁰ *Ibid*, 76.

⁸¹ *Ibid*, 79.

⁸² *Ibid*, 76.

APPENDIX C

Korean War (June 25, 1950 – July 27, 1953)

*“The wounded soldiers in Korea had a better chance of recovery than the soldier of any previous war. This was not only by virtue of improved medical treatments available at all echelons, but also in large measure because of his ready accessibility to major medical installations. ...” – Gen. Matthew B. Ridgway, Commanding General of the United Nations Forces in Korea*⁸³

In keeping with the military drawback after WWI and WWII, the Korean War necessitated filling the medical doctor ranks straight from civilian residency programs with 90% of the doctors stationed in Korea being draftees.⁸⁴ Once again, the largest portion of medical care was rendered by the Army Mobile Army Surgical Hospital (MASH) units. The Korean War marked the first time for truly mobile medical units in a deployed setting. MASH units were designed to be moved within 24-hrs of notice, exemplified by the MASH 8076 unit moving seven times in one year.⁸⁵ MASH units often times had to deal with deplorable operating conditions likened that of today’s austere environments, utilizing available spaces and adapting them to fit immediate surgical needs while prepping better spaces for work. Still, MASH surgeons were able to operate on soldiers within a few hours of injury.⁸⁶ Overcrowding at MASH units became an issue in itself with the 8076th successfully treating and evacuating 19,143 of the 21,408 patients received, with only 188 deaths, in 1951.⁸⁷ Poor roads and field conditions exacerbated ground evacuation methods and created problems within the medical system. The answer to this problem came by way of air.

Prior to 1951 most medical evacuations of wounded were performed by various ground vehicles. Declining road conditions and frequent maintenance issues rendered vehicle evacuation a serious threat to patients as they moved through the echelons of care. A change needed to happen and happen fast. By March of 1951, the birth of the first air ambulance service commenced in Korea and three medical Helicopter units (Sikorsky H-5, the Bell H-13, and the Hiller H-23⁸⁸) consisting of four choppers were deployed to the Korean theater to help remedy the challenge of patient evacuation.^{89,90} Figures 17, 18, and 19 show how the choppers were equipped with two litters mounted to each skid.



Figure 17, 18 and 19: Left to Right

The limited number of helicopter units meant only the highest priority medical cases were flown by air. The helicopter pilots were officers in the medical corps, and performed some triage and inserted blood and fluid intravenously preflight in order to stabilize the patient. However, there was often times no direct hands-on care for patients loaded to the skid mounts. Despite an overwhelming need for MEDEVAC helicopters during the Korean

⁸³ Zimmerman, Jon. “Battlefield Medicine in the Korean War.” Defense Media Network, 9 Feb 14. Accessed on 9 Feb 17 from: <http://www.defensemmedianetwork.com/stories/battlefield-medicine-in-the-korean-war/>

⁸⁴ Ibid, 78.

⁸⁵ Unknown Author. “Army Medicine in the Korean War.” Military History Blog Spot, 1 Nov 14. Accessed on 9 Feb 17 from: <https://militaryhistoryblogspot.wordpress.com/2014/11/01/army-medicine-in-the-korean-war/>

⁸⁶ Unknown Author. “Medicine in the War Zone.” Science Museum. Accessed on 8 Feb 17 from: <http://www.sciencemuseum.org.uk/broughttolife/themes/war/warzone>

⁸⁷ Ibid, 85.

⁸⁸ Ibid, 83.

⁸⁹ Ibid, 85.

⁹⁰ Ibid, 85.

War, their numbers were not that prevalent and required strict guidelines for usage: do not fly at night or into direct combat situations.⁹¹ These rules were not always followed as night provided good cover for extraction and time was of the essence. Helicopters also assisted with the delivery of blood and were used to deliver over 5,000 units to the frontlines.⁹² As useful as helicopters seems to be, did they really improve survivability in war?

WWII fatality rates for the seriously wounded was 4.5%. In the Korean War, that number was cut almost in half, to 2.5%, an astounding success attributed to the combination of the MASH units and the aeromedical evacuation system consisting of casualty CASEVAC and MEDEVAC helicopter.⁹³ For the history buffs, it is true that both types of evacuation had been developed and used to a limited extent prior to 1950, but it was in the Korean War that both were codified and used in an extensive manner. The Army and the Air Force agreed to helicopter transport for frontline rotary wing evacuation and the Air Force would provide fixed-wing aeromedical evacuation outside the combat zone.⁹⁴ Helicopters were used to transport more than 20,000 casualties during the war.

The Korean War also provided an opportunity to further medical care and equipment that would later on become standards of care in military and civilian medical communities. These advances include, but are not limited to: combat fatigue diagnoses, vascular reconstruction, artificial kidneys, lightweight body armor, new antibiotics, new anticoagulants, the use of whole blood for shock treatment and research on the effects of extreme cold on the body, which in turn led to development of better cold weather clothing and improved cold weather medical advice and treatment.^{95,96} For environmental and public health concerns, the following issues were factors for medical care: smallpox, typhus, cholera, malaria, tuberculosis, and Japanese B encephalitis. Poor sanitation and polluted water accounted for the more common maladies such as dysentery and other diarrheal diseases.^{97,98} Of the 1.5 million Americans fighting in Korea, over 100,000 were wounded and more than 33,000 killed in action.⁹⁹



⁹¹ Unknown Author. "Army Medicine in the Korean War." Military History Blog Spot, 1 Nov 14. Accessed on 9 Feb 17 from: <https://militaryhistoryblogspot.wordpress.com/2014/11/01/army-medicine-in-the-korean-war/>

⁹² *Ibid*, 91.

⁹³ Zimmerman, Jon. "Battlefield Medicine in the Korean War." Defense Media Network, 9 Feb 14. Accessed on 9 Feb 17 from: <http://www.defensemedianetwork.com/stories/battlefield-medicine-in-the-korean-war/>

⁹⁴ *Ibid*, 93.

⁹⁵ *Ibid*, 93.

⁹⁶ Herman, Jan K. and André B. Sobocinski. "Brief History of Navy Medicine." Washington, DC: BUMED, 2006. Accessed on 9 Feb 17 from: <http://www.koreanwar60.com/medical-advances>

⁹⁷ *Ibid*, 93.

⁹⁸ *Ibid*, 96.

⁹⁹ Unknown Author. "BUMED History Showcase: Navy Medicine in the Korean War." Navy Medical Official website. Access on 9 Feb 17 from: <http://www.med.navy.mil/bumed/nmhistory/Pages/showcase/Events/NMinKorea/main.aspx>

APPENDIX D

Vietnam War (November 1, 1955 – April 30, 1975)

The Vietnam War posed a unique challenge to providing medical care. The war was fought in triple canopy jungle terrain against constant guerilla attacks and an ever changing battle frontline with horrible weather patterns. Ground medical vehicles traveling on the roads were subject to landmines, ambushes and poor road conditions with some being so remote there were no roads. How would the military safely transport the wounded in a timely manner to aid stations and hospitals for proper care?

The Army's medical branch decided to revisit the air ambulance idea from the Korean War. In 1963, the 57th received their official call sign, "Dustoff", when their commander, Major Lloyd E. Spencer chose the name from the Navy Support Activity's call sign book.¹⁰⁰ The name stuck and the crews have evolved ever since as new missions dictated their capability sets to grow. In addition to the regular MEDEVAC missions, Dustoff crews flew hoist missions and night missions, of which were previously disallowed during the Korean War. From Vietnam forward, troop morale was raised knowing the Dustoff crews would come for them no matter the circumstance.¹⁰¹ During the war, another rotary airframe was added to the MEDEVAC capability, the "Huey" Bell UH-1. Helicopter MEDEVAC was so successful during this time that it translated back to the U.S. and incorporated into all trauma centers being fitted with heliports for life-flight delivery.¹⁰²

As medical evacuation went back to its Korean roots, the hospital system was not able to move as there were no longer established front lines and the terrain made MASH unit movement virtually impossible. Instead, surgical units gradually built more and more elaborate facilities with concrete floors and wooden buildings, providing better medical care capability.¹⁰³ How would the new Echelon system of care be exacted in the jungle environment?

In the previous wars, personnel served in their units for the duration. However, in the personnel surge for the Vietnam War, the Army chose to rotate individuals in piece-meal fashion overseas for one-year tours of duty in two years of service, whereby draftees trained for six months, deployed for 12 months, then returned for their remaining time.¹⁰⁴ When deployed staff members were spread out amongst the forward units to ensure no one unit had too many inexperienced members. Due to this type of rotation, it was possible for members to have very different experiences in the same facility year to year. The individual rotation policy was a compromise from World War II and Korea experience. In time the Army decided to handle long campaigns by rotating complete units instead of individuals.¹⁰⁵ Still this new personnel assignment method failed to provide enough medical support in the ranks of doctors and surgeons. The constant inundation with patients forced the medical corpsmen to take on drastically increased responsibilities, such as: bleeding stoppage in the field, emergency surgical airway openings, thoracic needle decompressions, and shock resuscitation.^{106,107} When these EMT and paramedic corpsmen returned to the States, they paved the way for the first Physician Assistant training program at Duke University Medical Center in 1965.¹⁰⁸

Despite the frequently rotating staff, U.S. military hospitals in Vietnam were premier for their time, incorporating lessons-learned and improvements from previous field hospitals. Army doctors were better trained with semi-permanent structures mentioned above. This made more advanced surgical procedures possible: more

¹⁰⁰ Unknown Author. "So Others May Live: Dustoff - Medical Evacuation in the Vietnam War." Texas Tech University, The Vietnam Center and Archive. Accessed on 17 Feb 17 from: <https://www.vietnam.ttu.edu/exhibits/dustoff/>

¹⁰¹ *Ibid*, 100.

¹⁰² Stepansky, Paul E. "An Irony of War." Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

¹⁰³ Et al. "Chapter Three: The Vietnam War." Borden Institute, U.S. Army Medical Department Center and School. Accessed on 10 Feb 17 from: <http://www.cs.amedd.army.mil/borden/filedownloadpublic.aspx?docid=b6ded33a-943d-40b0-aa91-7009e42c0a64>

¹⁰⁴ *Ibid*, 103.

¹⁰⁵ *Ibid*, 103.

¹⁰⁶ Cosgrove, Delos M. "Medical Lessons from the Vietnam War." Cleveland Clinic Health Essentials, 15 Jan 14. Accessed on 10 Feb 17 from: <https://health.clevelandclinic.org/2014/01/medical-lessons-from-the-vietnam-war/>

¹⁰⁷ *Ibid*, 102.

¹⁰⁸ *Ibid*, 102.

laparotomies, thoracotomies, aortic and carotid vascular repairs, “Vietnam Vascular Registry” (a database with 8000+ vascular wound cases performed by 600+ battlefield surgeons), advanced neurosurgery for head wounds, and the development of intensive care units with mechanical ventilators.^{109,110} One of the more modern advancements came with blood transfusions and associated with massive quantities of blood and blood products used to treat massive trauma. Blood was separated into fresh frozen plasma and platelets, and then patients were blood tested to match the individual component to the need such as low platelet count or low blood clotting factors. The practice of breaking down the blood products carried over into civilian life and are now common practice to prevent disseminated intravascular coagulopathy and prevent Adult Respiratory Distress Syndrome that resuscitation with whole blood and blood products.¹¹¹

With the previous mentioned goodness, delayed primary closure for wounds with a high likelihood of infection still prevailed as the go-to method for large wounds. The process was virtually unchanged over the years with slight variation in antibiotic dressing usage: dirt and contaminants were flushed out, bleeding was controlled, dead flesh was debrided, the wound was packed with sterile gauze, antibiotics were administered and the wound was watched for a few days to ensure no sign of infection before suture closure would occur.¹¹²

There were far more medications available for particular diseases than in earlier conflicts.¹¹³ However, in any given year, one in three soldiers was hospitalized for disease. Malaria, psychiatric problems, and ordinary fevers were at the top of the list, but quick, competent care meant a quick recovery with most soldiers returned to duty.¹¹⁴ Disease and vector-borne outbreak was mitigated with the spraying of Dichlorodiphenyltrichloroethane (DDT) and usage of mosquito netting in personnel quarters.

Vietnam also offered challenges for the medical logistics community. The quick surge in fighting forces meant higher wounded rates on the battlefield, creating a shortage of medical supplies and severely taxing the Defense Supply Agency who handled the medical supply chain across the Pacific.¹¹⁵ There were severe shortages in special medical items as well as routinely used items. This caused medications to be administered beyond expiration date and some items to be cleaned or partially sterilized and then re-used, a practice that would be frowned upon for consumable items used in today’s medical care.^{116,117}

In general, most Vietnam War wounds were caused by fragments, followed by blast and bullet injuries. Later studies showed the use of body armor helped reduce the number of fragmentary wounds when compared to bullet wounds and lower extremity injuries were more common than upper extremity wounds because of the numbers of mines and booby-traps, and body armor protected the chest more than the abdomen.¹¹⁸ When comparing numbers for different time periods, only about 2.8% of patients who reached a hospital died in Vietnam, slightly better than the 2.5% average in the Korean War, and a further improvement over World War II results.¹¹⁹ Researches surmise that the Dustoff crews made up the 0.3% difference in life expectancy rates with the more seriously wounded soldiers reaching the hospitals. Over the 18 years of U.S. involvement in the war, there was a total of 313,616 American soldiers wounded in action that were either seen at or taken care of by 26 deployed American hospitals.¹²⁰

¹⁰⁹ Et al. “Chapter Three: The Vietnam War.” Borden Institute, U.S. Army Medical Department Center and School. Accessed on 10 Feb 17 from: <http://www.cs.amedd.army.mil/borden/filedownloadpublic.aspx?docid=b6ded33a-943d-40b0-aa91-7009e42c0a64>

¹¹⁰ Stepansky, Paul E. “An Irony of War.” Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

¹¹¹ *Ibid*, 109.

¹¹² *Ibid*, 109.

¹¹³ *Ibid*, 109.

¹¹⁴ *Ibid*, 109.

¹¹⁵ Cosgrove, Delos M. “Medical Lessons from the Vietnam War.” Cleveland Clinic Health Essentials, 15 Jan 14.

Accessed on 10 Feb 17 from: <https://health.clevelandclinic.org/2014/01/medical-lessons-from-the-vietnam-war/>

¹¹⁶ *Ibid*, 109.

¹¹⁷ *Ibid*, 109.

¹¹⁸ *Ibid*, 109.

¹¹⁹ *Ibid*, 109.

¹²⁰ *Ibid*, 109.

APPENDIX E

Gulf War/Iraq War (August 2, 1990 – February 28, 1991/March 20, 2003 – December 18, 2011) and War on Terror (Afghanistan, October 7, 2001 – December 28, 2014; /ISIS in Syria – current engagement)

The Air Force began to differentiate itself in the late '90s from the traditional Army method of deployed hospital infrastructure. The old AF Theater Hospitals morphed into modular building blocks of capability known as Expeditionary Medical Support (EMEDS). This construct is discussed more in the OT&E AF section and in the AF DCS capability section in the main body of this paper.

After Operation Desert Storm, the Army Medical Department took a hard introspective look and came up with a number of initiatives to improve Soldier health, medical care during deployments and on the battlefield, and the training and tools that medical personnel have to deliver care. These efforts have built a more efficient, better integrated system of battlefield protection and combat casualty care.¹²¹ The following chronological listing highlights some of their more prominent developments and/or achievements¹²²:

1994 - Activation of U.S. Army Medical Command; Deployment Occupational & Environmental Health Surveillance
1995 - Forward Surgical Teams
1996 - Ongoing Research & Use of Telemedicine
1997 - UH-60L MEDEVAC Helicopter
1998 - Anthrax Vaccination Program; Combat Stress Control
2000 - Chemical-Biological Protective Shelter Systems
2001 - National Vaccine Health Center Established
2002 - DOD/VA Clinical Practice Guideline; High-Tech Bandages
2003 - Medical Communications for Combat Casualty Care (MC4) Deployed; Stryker Medical Evacuation Vehicle; Blood Container Allows Far-Forward Transfusions; Basic Combat Training Injury Prevention; Mobilization Medical Services; Hem-Con Bandage¹²³
2004 - Improved Combat Eye Protection; Addition of Apheresis Platelet Collection Capability
2006 - Battlefield Pain Control/Advanced Regional Anesthesia
2007 - Light Utility Helicopter (LUH), UH-72A MEDEVAC
2008 - Armed Forces Institute of Regenerative Medicine established; Combat Gauze Dressing
2009 - Rapid Aeromedical Evacuation; Malaria Rapid Diagnostic Device
2010 - Concussion Management
2011 - Adenovirus Vaccine, Types 4 and 7; On-the-Move Nutrient Delivery System

On the Navy side of the house, their story in the Middle East started in the 1940s. The U.S. Naval Medical Research Unit No. 3 (NAMRU-3) in Cairo, Egypt started in 1946 and is the oldest overseas laboratory that has operated continuously since its inception. Research efforts at NAMRU-3 have been extensive over the last 40 years and include vaccine and drug development and disease surveillance conducted by field studies in various Middle Eastern countries.¹²⁴ Consequently, when Operation Desert Shield began, the U.S. Military was ready to respond to environmental threats in the region. In August 1990, U.S. Navy preventive medicine personnel and scientists began evaluating infectious disease risks among deployed troops and later established the Navy Forward Laboratory (NFL) at the Marine Corps Hospital in El-Jubail, Saudi Arabia. At full operational capability (FOC), the NFL served as the theater-wide, infectious diseases reference laboratory for coalition forces. During Operation Desert Storm, the emphasis of the NFL shifted from infectious disease to the threat of biological warfare (BW) and the staff was augmented with staff and equipment to: e, the NFL diagnostic capabilities and staff were augmented during Operation Desert Shield to perform bacteriological identification and microscopy, immunologic-based assays for

¹²¹ Unknown Author. "Army Medicine Innovations Since Desert Storm." Accessed on 10 Feb 17 from: <http://armymedicine.mil/Pages/AM-Innovations-Since-Desert-Storm.aspx>

¹²² *Ibid*, 121.

¹²³ Stepansky, Paul E. "An Irony of War." Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from: <https://adoseofhistory.com/tag/wwii-medicine/>

¹²⁴ Unknown Author. "Military Medicine in Operations Desert Shield and Desert Storm: The Navy Forward Laboratory, Biological Warfare Detection, and Preventive Medicine." Accessed on 10 Feb 17 from: http://www.gulflink.osd.mil/pm/pm_refs/n38en014/med_navy.htm

detecting bacterial and viral antigens and antibodies, and PCR molecular techniques.¹²⁵ Collection and analyzation of samples during this time included biological matter (like blood) and environmental samples from soil, water and air collectors.¹²⁶

The most likely BW threat from Iraq, based on the best intelligence at the time, was from the use of weapons loaded either the bacteria that cause anthrax or botulism.¹²⁷ Despite a search for BW agents from clinical, environmental, and veterinary samples, no evidence of a BW agent was detected during Operation Desert Shield or Desert Storm.¹²⁸ Another lesson learned was that more rapid BW assay methods are needed, which has been the focus of the military's biological defense research program since the Persian Gulf War. The present number of BW agents that can be detected is now much expanded. New methods also have been designed to detect BW agents in a broad range of substances other than clinical samples, including soil and sand samples, water samples, and even samples obtained from hard surfaces by swabbing.¹²⁹

Since the end of the Gulf War, the forward laboratory concept has been institutionalized into the Forward Deployed Laboratory (FDL). Together with the FDL staff, Preventative Medicine Technicians (PMTs) advise the Surgeon General's staff on issues such as field sanitation, protection of food and water, proper immunizations, and the prevention of insect-borne diseases.¹³⁰ PMTs also advised unit leaders on efforts to recognize DNBI problems early, while they can be more readily controlled. On average, 6% of ground troops were treated per week for some type of illness or injury.¹³¹ However, this percentage was lower than in previous major conflicts involving U.S. military personnel. The good health of U.S. troops was due in part to comprehensive preventive medicine efforts, accurate and rapid laboratory diagnosis, and the extensive health care system that was established in Saudi Arabia during Operation Desert Shield.

Other general advances in medicine came by Allied Forces between the Iraq Wars such as transportable heart lung machines the size of a laptop computer and portable Trauma Life Support and Transport intensive care units.^{132,133} Still, further insight into patient movement was brought about by the military's new found dependence upon reports and the increase in use of technology and the computer to both file, track, and data mine the reports. During the Vietnam War it took an average of 45 days for a seriously injured soldier to be returned to the U.S., but in the second Iraq War it took less than 4 days, enhanced by the smaller more transportable equipment listed above.¹³⁴ This is an amazing fact in itself, but there were still ways to enhance casualty care and delivery with technology. In 1992 a U.S. General Accounting Office (GAO) Report for Operation Desert Storm detailed the following issues concerning patient movement¹³⁵:

“- Mobility & Evacuation and Regulation Problems- Ground ambulances could not be used as planned due to rugged terrain, a lack of navigational equipment, communication difficulties, and long distances between hospitals and the front lines. Even the air evacuation units were taxed by the distances from pickup points to the hospitals. The long distances required frequent refueling, and crews had trouble locating fuel points. Medical regulators, who direct the evacuation of casualties, were unable to perform their mission due to a lack of adequate equipment to communicate with ambulance units. As a result, ambulances evacuated casualties to only hospitals whose locations they knew. If the war had produced more casualties, this

¹²⁵ Unknown Author. “Military Medicine in Operations Desert Shield and Desert Storm: The Navy Forward Laboratory, Biological Warfare Detection, and Preventive Medicine.” Accessed on 10 Feb 17 from:

http://www.gulflink.osd.mil/pm/pm_refs/n38en014/med_navy.htm

¹²⁶ *Ibid*, 125.

¹²⁷ *Ibid*, 125.

¹²⁸ *Ibid*, 125.

¹²⁹ *Ibid*, 125.

¹³⁰ *Ibid*, 125.

¹³¹ *Ibid*, 125.

¹³² Unknown Author. “Medicine in the War Zone.” Science Museum. Accessed on 8 Feb 17 from:

<http://www.sciencemuseum.org.uk/broughttolife/themes/war/warzone>

¹³³ Stepansky, Paul E. “An Irony of War.” Blog at WordPress.com, 11 Feb 12. Accessed on 9 Feb 17 from:

<https://adoseofhistory.com/tag/wwii-medicine/>

¹³⁴ *Ibid*, 132.

¹³⁵ Conahan, Frank C., Et al. “OPERATION DESERT STORM: Full Army Medical Capability Not Achieved.” United States General Accounting Office, August 1992. Accessed on 10 Feb 2017 from:

<http://www.gao.gov/assets/160/152150.pdf>

unmanaged evacuation system could have led to the underuse of some hospitals and the overwhelming of others.

--Radios Had Limited Capabilities- Air ambulances were equipped with FM radios that only had an effective range of about 15 miles.

--Desert Conditions Degraded Air Ambulance Capabilities- According to Army reports, air ambulance support was neither adequate nor responsive, especially at night. This concern can be traced in large measure to the limitations of the UH-1 (Huey) air ambulances. The Army employed both the UH-1 and the UH-60 (Blackhawk) helicopters as air ambulances. The MH-60 "Blackhawks" were added to the rotary evacuation arsenal and had better lift, communication and navigational capability. Lessons learned assessments cite numerous problems with the use of UH-1 ambulances in the heat and dust of the desert. Problems with these ambulances included the following:

---The UH-1 was unable to perform day and night missions in bad weather because it lacked navigational aids and performance capabilities, such as a pilot's night vision system, which are available in other Army helicopters, including the UH-60. For extended periods of time and on a number of occasions during and immediately after the war, UH-1 air ambulances were unable to respond to urgent requests due to poor visibility.

---The UH-1 was inadequate for the role of direct support to forward maneuver divisions because of its lack of lift capability in hot weather, its short range and low speed, and frequent maintenance requirements.

---The UH-1 could not meet its primary mission of evacuating priority patients from forward units to a MASH and then on to a CSH, due to the distances involved and the limited fuel available at MASHs. The long distances required frequent refueling, and crews had trouble locating fuel points. Some air ambulances reported landing next to tanker trucks, tanks, and Bradley Fighting Vehicles to ask for fuel or for directions to the nearest fuel supply.

---The UH-1 lacks the additional armored protection afforded the UH-60 and does not possess an antimissile/rocket defense system.

In spite of these deficiencies, according to Army reports, units with the UH-1 were given the heaviest workloads, even though the more capable UH-60s were available. However, the evacuation capabilities of the UH-60s were also limited because of the speed of combat operations and because hospitals were far from the front line."

Other instances of record keeping during this time become important in later years when soldiers returned home and required follow-up care upon exiting active duty. The "Shell Shock and Battle Fatigue" syndromes resurfaced, but this time given a new name, "Gulf War Syndrome", which described a wide spectrum of illnesses and symptoms experienced by approximately 100,000 U.S. soldiers who served in the Persian Gulf War.¹³⁶ Over the years war syndrome maladies have been studied at length. Their symptoms are highly diversified and difficult to objectify, and thus, researchers have benefitted greatly from historic patient records of the major wars through today's engagements. Military missions provide optimal opportunities to study pathogenetic syndrome factors in a prospective fashion, in which military personnel can be evaluated before, during and after the war or peace mission."¹³⁷ This process still exists today and is embraced by the SOCOM Preservation of the Force and Family (POTFF) programs. Service members receive baseline testing and compared cognitively before and after routine training and deployment missions to look for abnormalities to help identify when treatment may be necessary for the abnormal spikes in human performance functions and indicators.

More information by way of surveys and unit status reports has helped to increase the MHS fundamental understanding and quantification of Service training when preparing personnel for deployment. Dr. Brian Carter's 1994 white paper, entitled "Ethical Concerns for Physicians Deployed to Operation Desert Storm", profiles a series of 600 questionnaires mailed out to current and retired physicians during Desert Storm. 354 physician responded with the following interesting aspects of their deployment experiences¹³⁸:

¹³⁶ Farlex, The Free Dictionary. "Gulf War Syndrome." Accessed on 10 Feb 17 from: <http://medical-dictionary.thefreedictionary.com/Desert+Storm+syndrome>

¹³⁷ Soetekouw, P.M.M.B., Et al. "Somatic Hypothesis of War Syndromes." European Journal of Clinical Investigation, 2000. Pgs. 630 – 641. Accessed via Amsterdam Free University online on 10 Feb 17 from: https://www.researchgate.net/publication/12433418_Somatic_hypotheses_of_war_syndromes

¹³⁸ Carter, Brian S., MD. "Ethical Concerns for Physicians Deployed to Operation Desert Storm." White Paper, Mil Med 1994. Accessed on 10 Feb 17 from: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwi5koOKh7vSAhWLOSYKHaZpA50QFggfMAE&url=http%3A%2F%2Ffisme.tamu.edu%2FJSCOPE93%2FCarter93.pdf&usg=AFQjCNHLXJPFSwoliwstnPW_Jwb7aQ4taQ

“Had the conflict been any longer or more intense, rationing of health care would have been necessary”. Others felt that “rationing” was an ever-present phenomena of war in their setting. Particular items felt to have been in short supply by some of these physicians included surgical packs and dressings, suture material, antibiotics, IV fluids, casting material, and water. However 44% of respondents states that they were adequately supplied for treating their anticipated Allied Coalition casualties and any additional civilian and EPW patients. Over 83% of respondents indicated that their unit commanders supported the concept of using their own medical supplies to treat all three categories of patients... 72% of respondents indicated that they had completed the Army’s Medical Management of Chemical Casualties Course, a course given over a period of days addressing the mechanism of action of chemical warfare agents, defensive measures to be taken against them (including the use of protective clothing, gas masks, and pharmacologic agents), decontamination procedures, and specific antidotes and treatments. Nevertheless, 50% of all respondents expressed that they did not feel adequately prepared to treat chemical warfare casualties. Most realized that multiple trauma compounded by chemical contamination or toxicity would encumber their decontamination and evacuation capabilities, and have a profound impact on triage of all casualties... Perhaps one of the most difficult adjustments for any physician to make in preparation for war is that of determining the appropriate standard of care in a given environment with limited resources. That standard by which western physicians are accustomed to practicing, especially in the United States, cannot be approximated in a wartime scenario. It proved difficult for most respondents to accept the limitations of the austere utilitarianism which the desert environment and war imposed upon them. Given a different progression of the war, greater casualty load, or use of chemical warfare agents, many expressed concerns that their efforts might be construed as futile.”

The unit status report example comes from the same 1992 GAO ODS Report for the Army in which a few of the principle findings were¹³⁹:

“In many cases, unit CCs did not reflect personnel deficiencies that could affect mission capability, as required by regulations. Therefore, decision makers did not know the actual unit status. If reports had been accurate, the Army might have either not mobilized deficient units or attempted to have the required personnel at the mobilization stations when the units arrived.

- Many Personnel Not Trained for Wartime Missions- Many doctors and nurses had not been trained during peacetime for Wartime Missions and lacked basic soldiering skills, had no chemical casualty training, had no field training, and were not familiar with their equipment.
- Some Hospitals Never Fully Equipped or Supplied- Hospitals got their supplies/equipment late or not at all.
- Some Hospitals Could Not Follow Doctrine- Lack of vehicles prevented onward movement of MASH units in full and/or in partial mobilization, meaning bed capacity and surgical capability was downgraded.”

The preceding paragraphs of information highlight the peaks and valleys that war brings. On one hand, many great things are now possible and came about by finding solutions to problems that wars brings, and on the other hand, the military continues to fail in some areas despite our numerous advances over the years. Reports and surveys like the above are integral to keep the military from repeating past mistakes and helping future planning with lessons of what not to do. I hope we are smart enough to dig them out and refresh ourselves when the time comes and we are on the ledge of repetition.

¹³⁹ Conahan, Frank C., Et al. “OPERATION DESERT STORM: Full Army Medical Capability Not Achieved.” United States General Accounting Office, August 1992. Accessed on 10 Feb 2017 from: <http://www.gao.gov/assets/160/152150.pdf>

APPENDIX F

Historical casualty rates from the major wars discussed in this paper's main body and appendices, as provided by the Defense Casualty Analysis System Report, 20 Apr 17. Available from: <https://www.dmdc.osd.mil/dcas/pages/casualties.xhtml>

Department of Defense						
PRINCIPAL WARS IN WHICH THE UNITED STATES PARTICIPATED						
Source: DMDC's Defense Casualty Analysis System						
War/Conflict	Branch	# Serving	Total Deaths	KIAs	DOW	Wounds Not Mortal
World War I	Total	4734991	116516	53402	63114	204002
1917 - 1918	Army	4057101	106378	50510	55868	193663
	Navy	599051	7287	431	6856	819
	Marines	78839	2851	2461	390	9520
World War II	Total	16112566	405399	291557	113842	670846
1941 - 1946	Army	11260000	318274	234874	83400	565861
	Navy	4183466	62614	36950	25664	37778
	Marines	669100	24511	19733	4778	67207
Korean War	Total	5720000	36574	33739	2835	103284
1950 - 1953	Army	2834000	29856	27731	2125	77596
	Navy	1177000	657	503	154	1576
	Marines	424000	4509	4267	242	23744
	Air Force	1285000	1552	1238	314	368
Vietnam Conflict	Total	8744000	58220	47434	10786	Hosp. Care Req'd. 153,303No Hospital Care 150,341
1964 - 1973	Army	4368000	38224	30963	7261	Hosp. Care Req'd. 96,802No Hospital Care 104,723
	Navy	1842000	2566	1631	935	Hosp. Care Req'd. 4,178No Hospital Care 5,898
	Marines	794000	14844	13095	1749	Hosp. Care Req'd. 51,392No Hospital Care 37,202
	Air Force	1740000	2586	1745	841	Hosp. Care Req'd. 931No Hospital Care 2,518
Persian Gulf War	Total	2225000	382	147	235	467
1990-1991	Army	782000	224	98	126	354
	Navy	669000	55	5	50	12
	Marines	213000	68	24	44	92
	Air Force	561000	35	20	15	9
War/Conflict	Branch	Total Deaths	KIAs	DOW	WIA's	Non-Hostile Deaths
Operation Freedom's Sentinel	Total	35	14	7	170	13
ao 4 May 17	Army	18	6	7	148	4
	Navy	0	0	0	4	0
	Marines	0	0	0	2	0
	Air Force	17	8	0	16	9
Operation Inherent Resolve	Total	39	6	4	34	29
ao 4 May 17	Army	17	2	3	12	12
	Navy	10	3	1	5	6
	Marines	3	1	0	16	2
	Air Force	9	0	0	1	9
Operation Enduring Freedom	Total	2346	1369	472	20091	503
ao 4 May 17	Army	1661	999	329	14204	333
	Navy	128	77	6	422	45
	Marines	458	245	133	4945	80
	Air Force	99	48	4	520	45
Operation New Dawn	Total	73	22	16	295	35
ao 4 May 17	Army	63	22	16	293	25
	Navy	6	0	0	0	6
	Marines	0	0	0	0	0
	Air Force	4	0	0	2	4
Operation Iraqi Freedom	Total	4411	2675	799	31954	930
ao 4 May 17	Army	3233	1920	610	22230	697
	Navy	103	62	1	648	39
	Marines	1023	664	188	8626	171
	Air Force	52	29	0	450	23

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