THE MEDICAL JOURNAL

FALL 2024

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UNITED STATES ARMY MEDICAL CENTER OF EXCELLENCE

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THE MEDICAL JOURNAL

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Note from the Editor

It is both an honor and a privilege to step into the role of Editor for The Medical Journal. As I assume this position, I am deeply aware of the journal's legacy as a cornerstone of military medical knowledge and innovation, and I am excited to contribute to its continued growth and impact.

The Army Medical Journal plays a critical role in disseminating knowledge that directly enhances our ability to save lives and improve the quality of care for our service members. It is this mission that drives my commitment to ensuring the journal continues to grow and develop with the latest publishing innovations to reach our stakeholders.

In the coming months, we will be focusing on expanding the reach of the journal by welcoming submissions that reflect the full spectrum of military medicine.

Our goal is to provide a platform for sharing insights that address the evolving challenges faced by military medical professionals, both in combat zones and at garrison.

Whether you are a long-time contributor or a first-time reader, your engagement with this journal is invaluable. Together, we can ensure that The Medical Journal continues to inspire and inform the military medical field. Thank you for your trust and support. I look forward to working with you all.

Duty First! Victory!

Thomas Reust
Editor, The Medical Journal

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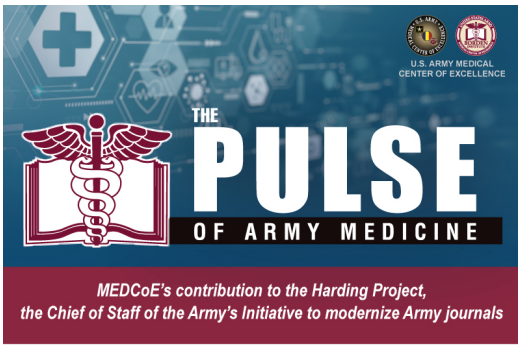

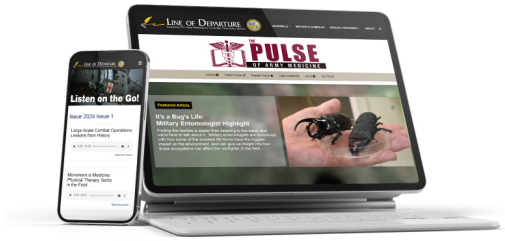

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West Point Department of Chemistry and Life Science: Strengthening Army Medicine through Leadership and Research

LTC Jeremy Hershfield, PhD, Kevin O'Donovan, PhD, LTC Andrew Kick, PhD, LTC Sara B. Mullaney, PhD, MAJ Stacey Bateman, PhD, COL (Ret.) Alan Beitler, MD, COL Jason Barnhill, PhD, M(ASCP), COL F. John Burpo, ScD

INTRODUCTION

With the transition from a multi-decade focus on low-intensity counterinsurgency operations to the prospect of near-peer competitor high intensity conflict in multiple theaters, the Army has a critical need for high quality physician-leaders. The continued evolution of the Defense Health Agency (DHA) and the military's increasing dependence on civilian medical providers further highlight the need for deployable uniformed physicians. Ensuring the health of our Soldiers and their families throughout the Army's global footprint is essential for a ready fighting force prepared for any contingency. Current operations in the Russo-Ukraine conflict remind us of the grim realities that combat brings to bear on those fighting on the front lines, as well as the varied nature of the threats and nature of casualties they inflict. This is especially important for chemical, biological, radiological, nuclear and explosives (CBNRE) threats.[1–5] Further, adaptive medical leaders with critical thinking, problem-solving skills, and organization leadership that transcend technical expertise are essential in fielding the leaders in the Medical Corps of the future.[6,7]

Army physicians usually enter military service through direct commission or a scholarship program, such as the Health Professionals Service Program (HPSP) or the Army Medical Department's Long-Term Health Education Training (LTHET).[8] While each of these options reliably supports the DoD's requirements for licensed military physicians, the United States Military Academy (USMA) at West Point is also a robust undergraduate source for future Medical Corps (MC) officers. In fact, USMA graduates routinely matriculate into many of the nation's top medical schools, such as Harvard, Yale, Stanford, and Columbia. While West Point only provides approximately 20 graduates each year to the MC pipeline, its graduates represent an extraordinary talent pool of scientific and leadership expertise, in part because of their experience in the Department of Chemistry and Life Science (CLS).

West Point provides a comprehensive 47-month experience in which military education, leadership, academics, and character development are intricately interwoven, as well as planned and executed by Army officers and civilian faculty. West Point faculty also either enhance their professional careers within the AMEDD or otherwise contribute to the medical mission during or following their teaching assignment. In this article, we describe how CLS supports the AMEDD officers through its faculty development, undergraduate education program, and teaching and leadership through research.

USMA DEPARTMENT OF CHEMISTRY AND LIFE SCIENCE

West Point was founded in 1802 to provide the Army and Nation officers and engineers to defend and expand the country's infrastructure.[9] While serving as the Superintendent of the United States Military Academy, Colonel Sylvanus Thayer saw the need for cadets to understand the basic sciences, to include chemistry and biology. He solicited help from the Surgeon General of the Army to develop courses and form a department to teach them. In 1820, a Department of Chemistry and Mineralogy was established, and the Head position was initially filled with the post surgeons, James Cutbush and James Percival. In 1838, the name changed to the Department of Chemistry, Mineralogy, and Geology, and was initially led by 2LT Jacob Bailey. The Department of Chemistry, Mineralogy, and Geology maintained its name for over one hundred years until it became the Department of Chemistry and Electricity in 1943. In 1946, the department name changed again to the Department of Chemistry and Physics. The department was ultimately renamed the Department of Chemistry and Life Science in 2002.

Today, the Department of Chemistry and Life Science teaches courses in Chemistry, Chemical Engineering, and Life Science and serves as the proponent for USMA's Premedical Scholarship Program. The mission of CLS is: *To educate cadets with a firm foundation in the fields of*

chemistry, life science, and chemical engineering so that each graduate is a commissioned leader of character who can leverage their understanding of science to implement solutions using appropriate problem-solving skills; and to inspire cadets to a career in the United States Army and a lifetime of personal growth and service to the nation.[10] In addition to offering three academic majors – American Chemical Society (ACS) accredited Chemistry, Accreditation Board for Engineering and Technology (ABET) accredited Chemical Engineering, and Life Science – CLS also offers a supplemental three-course Bioengineering track. The Department provides instruction in four core curriculum courses: CH101 General Chemistry I, CH151 Advanced General Chemistry I, CH102 General Chemistry II, and CH275 General Biology. CLS is also a member of the Photonics Research Center (PRC), along with the Departments of Physics and Nuclear Engineering (PANE) and Electrical Engineering and Computer Science (EECS), which conducts basic and applied research and support to the Army and DoD in the areas of lasers and photonics, giving future physicians research opportunities to understand and apply laser and imaging instrumentation. Collectively, the programmatic interdisciplinary nature of the Department is uniquely conducive to academically supporting top-tier premedical experiences.

With 25 military faculty, 10 civilian faculty, 13 administrative and laboratory staff, and numerous staff scientists and postdoctoral researchers, CLS serves the Academy, the Army, and the Nation by providing its graduates with a fundamental understanding of basic science and an advanced ability to solve complex problems. CLS maintains collaborative relationships across the DoD's science and technology research enterprise, including the Defense Threat Reduction Agency (DTRA), the Defense Advanced Research Projects Agency (DARPA), multiple entities of the U.S. Army Combat Capabilities Development Command (DEVCOM), the Chemical and Biological Center (CBC), the Army Research Laboratory (ARL), and multiple institutes of the Medical Research and Development Command (MRDC). The Department also hosts an Annual Microbiology Symposium, featuring renowned microbiologists from military and civilian research institutes and universities, and supports West Point's annual Summer Leaders Experience, a weeklong program that provides an immersive academic, military, physical, and social experience to high school juniors who will apply to become USMA cadets.

Table 1. USMA Table of Distribution and Allowances (TDA) Medical Service Corps authorizations for the Department of Chemistry & Life Science

Line	Position	Grade	Position Code	Degree
08	Instructor/ Researcher	O5	67B00	Ph.D.
13	Instructor/ Researcher	O5	67B00	Ph.D.
14	Instructor/ Researcher	O5	67B00	Ph.D.

CLS FACULTY IN THE AMEDD

Military faculty of CLS include permanent USMA professors, senior rotating faculty with PhDs, and junior rotating faculty with master's degrees.[11,12] AMEDD officers have fulfilled positions in all three categories.

CLS Academy Professors serve as tenured program and department leaders. Upon their selection, these officers become Functional Area 47 officers. Two recent Medical Service Corps (MSC) officers have received this distinction and served within CLS. COL Jason Barnhill, formerly a 71A Microbiologist, served as the Life Science Program Director. BG (Ret) Leon Robert, formerly a 72B Entomologist, rose through the academic ranks and retired as the Department Head, CLS. Both distinguished AMEDD faculty members were Adjunct Professors in the Uniformed Services University of the Health Sciences (USUHS) with multiple overseas and operational tours.

AMEDD Officers most commonly serve in CLS as senior rotating faculty, both due to medical-focused experience and by virtue of their doctoral degrees. The Tables of Distribution and Allowances (TDA) personnel authorizations for CLS currently includes three positions for AMEDD Laboratory Science (67B) officers with PhDs (Table 1) in topics relevant to biology and chemistry courses taught in the Department. These positions have historically been filled by 71A Microbiologist and 71B Biochemist officers, with one from each specialty filling at least one slot. Additionally, O1A branch immaterial positions are now able to be filled with other Areas of Concentration (AOC), such as 72B Entomologists or Veterinary Corps (VC) officers.

The junior rotating faculty is comprised of department-level committee-selected senior company grade and junior field grade officers who have received 2-year thesis-based Master's degrees in various chemistry, biology, and bio/chemical engineering programs through the Advanced Civil Schooling (ACS) program. While assigned to CLS, these officers serve as Instructors and Assistant Professors for the Department's core courses. Many junior rotators work closely with AMEDD officers assigned to CLS, and similarly lead and mentor premedical students. In some cases, these professional relationships inspire junior rotating faculty to subsequently pursue PhDs and return to USMA as senior rotators, either within their branch or as Functional Area 52 Nuclear and Countering Weapons of Mass Destruction (CWMD) officers. Two recent rotating USMA officers pursued professional degrees and

branch-transferred to the AMEDD, with one becoming a Microbiologist (COL Barnhill) and the other becoming a Dermatologist (LTC Ford Lannan).

Regardless of faculty type, CLS officers serve in various leadership roles. Each academic course has a Course Director (CD), responsible for course content and assessment plans. Each academic program – Chemistry, Life Science, and Chemical Engineering – has a Program Director and Deputy Program Director, who are responsible for resourcing with guidance, staffing, space, and materials. Research within CLS, the Center for Molecular Science, is also managed and led by a Program Director. Many of these roles are filled by senior rotator AMEDD faculty.

Both AMEDD and non-AMEDD officers contribute to Army medicine while serving as CLS faculty. West Point cadets and faculty regularly present basic and applied research at international meetings and conferences hosted by organizations such as DTRA, the American Society for Microbiology, and the American Chemical Society. CLS faculty also serve on review panels, boards, and advisory councils relevant to AMEDD's clinical and operational missions.[11,12] During the COVID-19 pandemic, AMEDD officers assigned to CLS served in staff roles at USMA and deployed as subject matter experts. Finally, following their respective tenures with CLS, AMEDD officers have completed fellowships and served in drug laboratories, MRDC laboratories, and Medical Centers. Two CLS faculty, LTC Erin Milner and COL (Ret) Norman Waters, later served as the Deputy Consultant and Consultant to the U.S. Army Surgeon General for Biochemistry and Microbiology, respectively.

CLS GRADUATES IN THE AMEDD

Education is critical at all levels in the career development of AMEDD officers, which starts with undergraduate programs and progresses through advanced military and civilian schooling. Chemistry, Life Science, and Chemical Engineering graduates support the AMEDD in wide ranging capacities. In part based on their passion for lessons learned throughout their CLS programs of instruction, these graduates align well with the AMEDD's mission of "ready and sustained health services support and force health protection in support of the Total Force."[13]

West Point alumni are represented in nearly all components of the AMEDD, including the Medical Corps, Nurse Corps, Dental Corps, Veterinary Corps, Medical Service Corps, Medical Specialist Corps, and Civilian Corps. Cadets interested in healthcare-related career fields are authorized to enter the MSC directly from West Point, but must first serve in a different branch before transferring to the other AMEDD branches. West Point graduates serve as MSC officers in wide-ranging roles, from medevac pilots and laboratory scientists to managers of the U.S. Army's health service. An additional cohort of West Point graduates temporarily joins the MSC when they are accepted into medical school following graduation, before transitioning to the Medical Corps after receiving their M.D. or D.O. degrees. There are additional paths for West Point graduates to join the other AMEDD branches. In many cases, West Point graduates apply as junior officers for release from their branch to enter professional schooling prior to completing their Active-Duty Service Obligation (ADSO). In other cases, graduates complete their ADSO, earn their professional degree, and return to active duty. Regardless, rooted in their 47-month leadership and character development experience at USMA, graduates bring a wide range of experiences, highly desirable qualities, and valuable leadership skills to the AMEDD.

West Point's premedical program has a long history. The first West Point graduate to attend medical school, Dr. Dorsey Mahin (West Point, 1945), was commissioned as an engineer, graduated from the Columbia College of Physicians and Surgeons in 1955, and retired as a colonel in 1972. He was required to resign his commission to attend medical school, a practice that continued for a decade. Later, Doctors John Fegin and Pauk Lenio (West Point, 1955) helped change the path to medicine for subsequent generations. As Lieutenants, these industrious officers presented their case to the Army Chief of Staff, GEN Maxwell Taylor, who reportedly said, "If you can make it work for the Army – do it."[14] Joined by classmate Preston Mayson, the three aspiring physicians attended medical school while on leave without pay. They all completed their residency training at Walter Reed Army Medical Center, then volunteered to serve in Vietnam.14 Army Regulation (AR) 601-112, which was first approved in 1968 as the Program for Medical, Dental, and Veterinary Education for Regular Army Officers, and subsequently amended to include Osteopathic education, allowed qualified officers to attend professional schools with government funding after serving a minimum of two years in the combat arms.15 Subsequently, members of the Class of 1970 were the first West Point graduates to receive permission to enter medical school directly from the academy.[14]

Since 1979, West Point cadets have attended medical school immediately following graduation from West Point in accordance with AR 601-141, which states: "The Superintendent, U.S. Military Academy (USMA) is responsible for preliminary selection of cadet applicants for HPSP participation and notification of selected cadets to USAREC for processing. DOD guidance permits only two percent of each academy graduating class to attend medical school under military sponsorship, effective 19 August 1978."[16] Thus, the DoD currently permits two percent of each West Point graduating class to attend medical school under military sponsorship. Many additional West Point graduates attend medical school following a period of service in the MSC or a branch outside the AMEDD. In recent years, between 75% and 100% of cadets aspiring to directly attend medical school upon graduation have majored in CLS, and overwhelmingly

in Life Science. Those cadets who select majors in other departments must take a heavy load of chemistry and biology classes (General Chemistry II, Organic Chemistry I, Organic Chemistry, II, Advanced Biology, Human Physiology, and Biochemistry), in addition to their academic major requirements, to meet medical school prerequisites.

West Point cadets bring highly desirable qualities and attributes to the medical school application process, aligning extremely well with the fifteen core competencies established by the American Association of Medical Colleges (Figure 1).[17] In addition, cadets perform exceptionally well throughout the medical school application process (Table2). Their acceptance rate over the past six years has averaged 95% and they have attended a wide range of medical schools, including Federal, state, and private institutions (Table 3). Approximately 98-99% of West Point graduates complete their residency training in the military graduate medical education system.

Figure 1. American Association of Medical Colleges core competencies

In all, 1168 USMA graduates have served as military physicians.[1] West Point alumni have become leaders in all aspects of medicine, both military and civilian. They have served as department chairs in prestigious universities and senior executives in healthcare organizations. Fourteen USMA graduate physicians have become General Officers, including three who attained the rank of Lieutenant General (LTG): former Surgeons General of the Army, LTG James Peake (WP'66) and LTG Nadja West (WP'82), and the current Director of the Defense Health Agency, LTG Telita Crosland (WP'89). Finally, six physicians have earned West Point's Distinguished Graduate Award (Table 4), which is conferred upon individuals whose "character, distinguished service, and stature draw wholesome comparison to the qualities for which West Point strives, in keeping with its motto: "Duty, Honor, Country."[18]

In addition to service as MSC officers and physicians, West Point CLS graduates have made significant contributions throughout the AMEDD. USMA graduates have earned professional degrees as dentists (n=23), veterinarians (n=7), and doctorate level physical therapists (n=15) between 1990 and

Table 2. Medical school acceptance data for West Point graduates, 2018 – 2023

	2018	2019	2020	2021	2022	2023
Applied	15	20	20	16	15	16
Accepted	14	19	20	15	13	16
Life Science Majors	8	13	17	12	11	15
Other Majors[a]	7	7	3	4	4	1
Total interviews	26 (1.7)	91 (4.55)	103 (5.2)	84 (5.3)	74 (4.9)	114 (7.1)
Total acceptances	19 (1.3)	55 (2.75)	61 (3.1)	52 (3.3)	46 (3.1)	65 (4.1)
USU interviews	13 (0.87)	20 (1.0)	20 (1.0)	16 (1.0)	15 (1.0)	16 (1.0)
USU acceptances	12 (0.8)	16 (0.8)	14 (0.7)	12 (0.75)	12 (0.8)	14 (0.9)
Civilian interviews	12 (0.87)	71 (3.6)	83 (4.2)	68 (4.3)	59 (3.9)	98 (6.1)
Civilian acceptances	7 (0.47)	39 (1.95)	47 (2.4)	40 (2.5)	34 (2.3)	51 (3.1)

[a]Other majors: Chemistry, Chemical Engineering. Kinesiology, Psychology, Environmental Science, Mechanical Engineering, Mathematical Science, Foreign Language, Interdisciplinary Science, Nuclear Engineering

Total numbers in black. Average numbers per cadet in blue. USU – Uniformed Services University.

Table 3. Medical Schools attended by West Point graduates, 2018 – 2023

Brown University
Southern Illinois University
Case Western Reserve University SOM
St. Louis University
Columbia University
Stanford University
Cornell University
Texas A&M University
Dartmouth College
Tufts University
Drexel University
UCLA
Georgetown University
Uniformed Services University
Harvard University
University of Arizona - Phoenix
Louisiana State University, New Orleans
University of North Carolina
Mayo Clinic
University of Oklahoma HSC
Medical College of Wisconsin
University of Texas, Houston
Medical University of South Carolina
University of Texas HSC
Michigan State CHM
University of Virginia
Michigan State COM
University of South Carolina Greenville
Morehouse SOM
Vanderbilt University
Nebraska – UNMC
Wake Forest University
Nova Southeastern COM
Washington State University
Penn State University
Yale University
Rocky Vista University COM

CHM – College of Human Medicine; COM – College of Osteopathic Medicine; HSC – Health Science Center; SOM – School of Medicine; UNMC – University of Nebraska Medical Center; UCLA – University of California Los Angeles

2020.[2] Thus, West Point graduates bring their military experience, unparalleled leadership education and training, and character development to classmates in professional schools and colleagues throughout the military. The lessons learned during CLS courses in Bartlett Hall's classrooms and laboratories, as well as mentorship from members of the CLS staff and faculty, provide the backbone for exceptional careers of service in the AMEDD.

CLS LEADS PREMEDICAL TRAINING

Although only a small percentage of Army physicians and other supporting officers are West Point graduates, they nonetheless distinguish themselves through their undergraduate experience of integrated leadership development in military, physical, character, and academic instruction. As the USMA proponent for the premedical program, CLS specifically strengthens the AMEDD through cultivation of undergraduates and career professionals via military medicine-tailored academics, premedical club coordination, summer internships, and teaching through research.

LIFE SCIENCE PROGRAM: ACADEMICS AND ASSESSMENT

Most West Point graduates who become physicians, either directly following graduation or later during their Army careers, major in Life Science. Between 2018 and 2023, 74.5% (76 of 102) direct medical school attendees majored in Life Science (see Table 2). Except for Physics, CLS teaches all science courses that are required for premedical students: Biology, Organic Chemistry, Human Physiology, and Biochemistry (Table 5), and each of these courses is also required for the Life Science major.

Table 4. Physician recipients of the West Point Distinguished Graduate Award

Thoralf M. Sundt Jr. WP'52
John A. Feagin, WP'55
James B. Peake, WP'66
Victor F. Garcia, WP'68
Frederick C. Lough, WP'70
Nadja Y. West, WP'82

CLS courses are taught and/or directed by MSC Officers, who provide rigor and mission-specific applicability that is unique among the typical American undergraduate STEM experience. The Human Anatomy class has been taught by a physician from Keller Army Community Hospital (KACH). Furthermore, the Biotechnology capstone course for Life Science majors has been designed and executed in conjunction with USUHS faculty, which further highlights the strong connection between CLS and Army medicine.

CLS offers its robust Life Science academic major at near-capacity, with enrollment of approximately 40 cadets per year. Simultaneously, many non-Life Science majors take several upper-level courses to meet or otherwise supplement medical school applications. The Life Science program is strengthened by its diversity of military and civilian faculty. Military faculty represent non-AMEDD branches, such as Signal Corps, Military Intelligence, Chemical Corps, and FA52 Nuclear and CWMD, as well as AMEDD branches, such as VC and MSC (71A Microbiologists, 71B

Biochemists, and 72B Entomologists). Civilian faculty, with and without military backgrounds, have PhDs in fields such as microbiology, biochemistry, and neuroscience.

The Life Science course sequence (Table 6) begins in the fall semester of a cadet's sophomore year with Advanced Biology, followed by Genetics in the spring. In their junior year, Life Science majors take Cell Biology in the fall and both Biochemistry and Human Physiology in the spring. Either during their junior year spring semester or immediately following the conclusion of the spring semester, premedical cadets take the Medical College Admission Test (MCAT). Upon returning to USMA from summer military training, Life Science seniors take Microbiology in the fall and a capstone Biotechnology course in the spring. In addition to this biology-focused course sequence, Life Science majors also take one full year each of General Chemistry and Organic Chemistry. With the exception of Genetics, all these courses have coupled laboratory programs, ensuring that cadets gain practical knowledge of chemical and biological instrumentation and experimental techniques. Life Science majors also complete two required elective courses, which commonly include Human Anatomy, Advanced Techniques in Light Microscopy, or Biological Psychology. Recently, CLS has added a three-course bioengineering track of instruction, consisting of Biomedical Engineering, Bioprocess Engineering, and Bioengineering Modeling, Analysis, and Design, which has begun to enhance the undergraduate experience of several premedical Life Science majors.

As the centerpiece for the Department's support of not only premedical cadets, but many of the Academy's future MSC officers, the Life Science program is a remarkably effective product of its civilian and medically oriented military faculty. Within the Life Science Program, its students are assessed using externally derived direct evidence from three standardized tests:

- Medical College Admission Test (MCAT), taken by 30 – 50% of Life Science majors in the spring of junior year,
- American Chemical Society (ACS) Biochemistry Exam (one semester course), taken by all Life Science and all Chemistry majors, typically during spring of junior year, and

Table 5. CLS courses that are required for West Point's Premedical Scholarship Program, and their status within each CLS major

Course Designation	Course Title	Life Science	Chemistry	Chemical Engineering
CH102	General Chemistry II	Required	Required	Required
CH383	Organic Chemistry I	Required	Required	Required
CH384	Organic Chemistry	Required	Required	Not required
CH375	Advanced Biology	Required	Elective	Not required
CH387	Human Phisiology	Required	Elective	Not required
CH473	Biochemistry	Required	Required	Not required

Figure 2. Life Science performance on the ETS Major Field Test for Biology, 2021 – 2022

ETS Major Field Test AY21

Assessment Indicator Title	USMA Mean Percent Correct	USMA Percentile	National Mean Percent Correct	National Percentile
Biochemistry and Cell Energetics	53%	91st	43%	45th
Cellular Structure, Organization, Function	56%	89th	44%	43rd
Molecular Biology and Molecular Genetics	53%	89th	42%	47th
Diversity of Organisms	62%	86th	53%	40th
Organismal - Animals	53%	94th	41%	45th
Organismal - Plants	42%	74th	38%	51st
Population Genetics and Evolution	50%	85th	41%	44th
Ecology	62%	99th	46%	44th
Analytical Skills	56%	93rd	44%	45th
Average	**54%**	**89th**	**44%**	**45th**

	USMA Average Score	USMA Percentile	National Average Score	National Percentile
Subscore 1: Cell Biology	61	92nd	51	43rd
Subscore 2: Molecular Biology and Genetics	62	93rd	52	45th
Subscore 3: Organismal Biology	60	91st	51	41st
Subscore 4: Population Bio, Evolution, Ecology	62	95th	50	40th
Total Score	162	93rd	152	48th

ETS Major Field Test AY22

Assessment Indicator Title	USMA Mean Percent Correct	USMA Percentile	National Mean Percent Correct	National Percentile
Biochemistry and Cell Energetics	57%	97th	43%	45th
Cellular Structure, Organization, Function	62%	98th	44%	43rd
Molecular Biology and Molecular Genetics	58%	97th	42%	47th
Diversity of Organisms	61%	83th	53%	40th
Organismal - Animals	54%	96th	41%	45th
Organismal - Plants	43%	78th	38%	51st
Population Genetics and Evolution	51%	87th	41%	44th
Ecology	64%	99th	46%	44th
Analytical Skills	60%	98th	44%	45th
Average	**57%**	**93rd**	**44%**	**45th**

	USMA Average Score	USMA Percentile	National Average Score	National Percentile
Subscore 1: Cell Biology	64	98th	52	50th
Subscore 2: Molecular Biology and Genetics	65	97th	53	49th
Subscore 3: Organismal Biology	60	91st	52	49th
Subscore 4: Population Bio, Evolution, Ecology	63	97th	51	47th
Total Score	165	98th	152	46th

Table 6. Recommended CLS course sequence for West Point Life Science majors

Sophmore		Junior		Senior	
Fall	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
CH375 Advanced Biology	CH388 Genetics	CH385 Cell Biology	CH387 Human Physiology	CH457 Microbiology	CH479 Biotechnology (Capstone)
CH383 Organic Chemistry I	CH384 Organic Chemistry II	N/A	CH473 Biochemistry	N/A	N/A

- Educational Testing Services (ETS) Major Field Test (MFT) in Biology, taken by all Life Science majors during their spring of senior year.

The Biology MFT is the best holistic assessment of the program, since all Life Science majors take this exam just prior to the conclusion of their 47-month West Point experience. The Biology MFT provides a broad-based assessment of the academic program as well as a benchmark against a national standard, either on a student or institutional level. From 2018-21, 24,092 seniors at 403 U.S. institutions took the Biology MFT. West Point's Life Science majors averaged a total score Biology MFT in the 93rd percentile, compared to the 48th percentile national average (Figure 2). Thus, USMA Life Science cadets outperform the Biology MFT national average by >45 percentile points (162 v. 152 raw score). Furthermore, USMA cadets consistently scored significantly higher than the average in all categories: Cell Biology, Molecular Biology/Genetics, Organismal Biology, and Population Biology/Evolution/Ecology.

CLS LEADS THE WEST POINT PREMEDICAL SOCIETY (WPPMS)

In addition to academically supporting premeds through the Life Science major, a Microbiologist, Biochemist, or Veterinarian in CLS serves as the Officer-in-Charge of the West Point Premedical Society (WPPMS). The WPPMS supports the AMEDD mission, to "provide ready and sustained health services support and force health protection in support of the Total Force to enable readiness and to conserve the fighting strength while caring for our People and their Families,"[13] by creating opportunities for prospective cadets with a passion for pursuing a career in military medicine. The club strives to inform and advise members on such opportunities afforded to them in pursuit of preserving the fighting strength. In addition, the club exposes cadets to research, clinical, and community service practices to develop a medical professional that embodies Duty, Honor, and Country.

Cadet leadership of WPPMS is a hallmark of the premedical experience, in keeping with USMA's status as the world's premiere leadership institute. WPPMS provides leadership opportunities for cadets who are dedicated to the medical profession. Cadet leadership roles include President, Vice President, Secretary/Shadowing Coordinator, Public Affairs Officer, Treasurer/Concessions, and Volunteer Coordinator. Cadets who serve in these leadership roles, typically during their junior year, routinely earn numerous academic awards and matriculate at top-tier medical schools.

The cadets who lead WPPMS plan and execute many activities for its members during the academic year, focused on volunteering (selfless service), physician shadowing, evening seminars, book club, basic medical training events, fundraisers through USMA athletics concession sales, and trips to medical schools. In one annual event, Army 68K medics provide hands-on basic medical school training to club members, including basic suture skills labs, cardiopulmonary resuscitation techniques, and basic life support training. Other major club events include an annual Medical School Celebration to honor cadets who attend medical school

Figure 3. Representative summer research and physician shadowing internships offered by the Life Science program within the Department of Chemistry & Life Science

immediately following graduation, and a Medical Scholars Retreat for cadets who apply to West Point's internal medical school selection board. The cadet Volunteer Coordinator plans and executes monthly trips to the Food Bank of the Hudson Valley. Typically, 12 cadets are authorized to volunteer during each session, accruing hours towards selfless service, which is a key component of medical school applications. The cadet Secretary/Shadowing Coordinator works with KACH to schedule physician shadowing excursions for club members. Currently, shadowing during the academic year occurs bimonthly in all major KACH Departments. In 2022, the Veterinary Treatment Facility (VTF) on West Point also volunteered to provide VC Officer shadowing opportunities to club members who may also be interested in pursuing a future career in veterinary medicine. Finally, the cadet President of WPPMS coordinates recurring evening seminars, bringing in various speakers from across Army Medicine. These guest speakers share their respective professional journeys and are a great resource for club scholars as they forge their own paths to medical school.

The WPPMS cadet President works with the OIC to plan and execute an annual trip section, giving club members the opportunity to travel outside West Point. In 2022, WPPMS brought cadets to the National Capital Region, where they visited three medical schools, the Uniformed Services University School of Medicine, Georgetown University School of Medicine, and George Washington Medical School, and met with medical students who will enter the Army upon graduation. Through such trips, aspiring future physicians from West Point directly compared their options of attending the DoD's military medical school or a civilian medical school. Cadets also met with active-duty physicians with various specialty certifications from Walter Reed National Military Medical Center (WRNMMC) and learned more about their respective career paths.

CLS ACADEMIC INDIVIDUAL ADVANCED DEVELOPMENT PROGRAM

In addition to its oversight of WPPMS, CLS coordinates and offers summer physician shadowing and research opportunities to further enhance the undergraduate premedical experience. Funded largely by DEVCOM, DTRA, and West Point's Association of Graduates, the Department sends approximately 50 cadets each summer to various Academic Individual Advanced Development (AIAD) internships that are managed and offered respectively by the Chemistry, Chemical Engineering, and Life Science programs. CLS summer internships with DoD and civilian partners fall into two broad categories: medical shadowing and research (Figure 3).

Medical shadowing AIADs, which are predominately physician shadowing but may also include veterinarian shadowing, are key developmental opportunities for cadets to interface with Military Medicine and various clinical disciplines. These programs also enable premedical cadets to log as many as 120 hours of shadowing time, which are critical for their medical school applications. Physician shadowing AIAD opportunities are the largest block of Life Science offerings, with ~20-25 cadets participating each summer. In addition to previous opportunities at Landstuhl Army Regional Medical Center and Madigan Army Medical Center, physician shadowing AIADs annually occur at WRNMMC and Brooke Army Medical Center (BAMC), where cadets shadow in numerous medical departments, such as general and orthopedic surgery, neurology, pediatrics, endocrinology, and emergency medicine.

Often, cadets shadow physicians at local Army clinics and civilian hospitals when participating in research AIADs, which provide cadets with dedicated time to hone their ability to ask critical questions, analyze data, and conduct experimentation through research. Like physician shadowing, research experiences are also crucial aspects of medical school applications. Furthermore, research AIADs closely align with West Point's Academic Year 2024 theme of the exploration of innovation and technology and how it shapes warfare and the national defense strategy. The Disease Biophysics group at Harvard University hosts 3-4 cadets as part of an interdisciplinary research study with CLS majors, most of whom are premedical students, in the Department's Multifunctional Materials Laboratory. Cadets also conduct research in DoD laboratories, such as USAMRIID, WRAIR, and ARL (see Figure 3), which provides them with unique real-world experiences of working alongside DoD scientists to address DoD problems. Although many cadets participating in research AIADs choose careers outside medicine, they nonetheless develop their ability to work in complex environments and adapt rapidly to an increasingly technological battlespace. Thus, the Department's research internships align with the Army Modernization Strategy and the Secretary of the Army's 2nd objective, "to ensure the Army becomes more data-centric and can conduct operations in contested environments, which will enable our ability to prevail on the future battlefield."[19]

Nearly all members of the West Point Classes of 2018 through 2023 who attended medical schools and/or become Army physicians participated in shadowing or research AIADs coordinated through CLS. Crucially, many of the research AIADs provided by CLS are also tied to ongoing research within the Department, wherein cadets expand on the depth and breadth of their undergraduate research experience.

CLS TEACHES THROUGH RESEARCH

In addition to providing required courses, leadership, mentorship, and internship, CLS leads West Point in providing year-round research opportunities for its students to successfully begin their journeys towards careers in

medicine. "Teaching through research" explains undergraduate research as a critical component of USMA's leader development model and its core mission "to educate, train, and inspire". Recognizing the value and benefits of an undergraduate research experience (URE) is not unique to West Point; peer-reviewed educational research consistently affirms the numerous benefits of an URE. As a brief summary of broad research studies, college graduates who participate in UREs report higher self-evaluation of their skills in communication, research, critical thinking, and leadership.[20–22] Additionally, completing an URE increases student interest in research and likelihood to complete a STEM Ph.D. or other graduate program.[23–25] Furthermore, students who publish as undergraduates are more likely to publish a greater number of articles, and in higher impact journals after graduation.[26] Life science students who continue in an URE typically report positive experiences and enjoy both the culture and everyday tasks of research laboratories.[27] Finally, formally designed and funded summer UREs significantly increase the outcomes of Ph.D. completion, publication output, and encouragement of underrepresented groups to choose careers in STEM.[28]

These same outcomes have been strikingly evident in the past few years since CLS formally implemented a research course sequence, which is taken by nearly all premedical students. Cadets can enroll in 200, 300, and 400-level research courses at 1, 2, and 3 credit hours, respectively. As early as freshman fall semester, cadets meet with CLS faculty members and upper-class research students to discuss potential topics of

Figure 4. USMA Class of 2023 recipients of medical school scholarships. Each graduate majored within the CLS Department. Top row: Gerald Moore, Honors, 11 research credit hours, Morehouse; Dalton Ennis, 9.5 research credit hours, St. Louis University; William Rankin, Honors, 13 research credit hours, Mayo Clinic Arizona. Second row: Riley McHale, 8.5 research credit hours, Michigan State COM; Malina Hatton, Honors, 15.5 research credit hours, Harvard; Erika Rapp, Honors, 11.5 research credit hours, Michigan State CHM; Liam Sasser, Honors, 11.5 research credit hours, Cornell. Third row: Alex Burgess, Honors, 11 research credit hours, Stanford; Aidan Wright, Honors, 14 research credit hours, Dartmouth; Alicyn Grete, Honors, 10.5 research credit hours, USUHS; Sophia Mckenzie, Honors, 11 research credit hours, USUHS; Dagan Herring, 3.5 research credit hours, USUHS. Fourth row: Anthony Amaru, Honors, 11.5 research credit hours, Georgetown; Victoria Lam, Honors, 9.5 research credit hours, North Carolina; Abigail Graham, Honors, 9.5 research credit hours, Columbia; Taylor Miller, Honors, 11.5 research credit hours, Dartmouth

interest. During freshman spring semester, cadets enroll in a 200-level research course, which requires cadets to conduct at least 2.5 hours of research per week throughout the semester. During this time, students are typically trained by upper-class cadets enrolled in 300-level (≥five research hours per week) and 400-level (≥7.5 research hours per week) research courses. Chemistry and Life Science majors who complete two semesters of 400-level research may graduate with honors, depending on their grade point average. Most cadets who begin as freshmen continue research with the same mentor and team until they graduate, enabling a multi-year URE that results in learning, communication, advanced STEM training, and leadership outcomes consistent with the literature. The Department's research partnerships and collaborations dovetail with three-to-four-week research AIADs, wherein cadets apply their skills in a DoD-affiliated or university collaborator's laboratory during the summer.

West Point's multi-year URE leverages a leadership development model to develop future Army officers as leaders in medicine or science and technology. Within CLS, established principal investigator's (PI) laboratories are largely run by upper-class cadets, with each PI mentoring and leading the upper-class students with the support of postdoctoral researchers and staff scientists. Summarily, upper-class cadets lead, train, and mentor under-class students. This model for undergraduate research provides several advantages: faculty time is conserved, upper-class cadets develop vital leadership experience in a technical environment, and under-class cadets are optimally positioned to assume leadership roles, thereby creating a sustainable model. Additionally, multi-year research projects engage and develop cadets' scientific foundations, critical thinking, and problem-solving skills far beyond the capacity of other 3.5-hour academic courses. Thus, teaching through research is a large component of the CLS mission and its vital contributions to the Army of 2030 and beyond.

Cadets who complete multi-year research experiences in CLS are afforded significant opportunities for academic competitions, conference presentations, and peer-reviewed publications. Unsurprisingly, these myriad accomplishments routinely enable CLS majors to win highly competitive graduate scholarships, which include attendance at medical schools, further developing high-quality officers and validating USMA as a top-tier undergraduate institution (see Table 3 and Table 7). The consistency with which CLS cadets win these scholarships is in part due to the Department's URE model. Cadets share their results and conclusions as speakers and poster presenters at national conferences and co-author peer-reviewed publications. Between 2018-2022, approximately 30% of publications by staff and faculty in CLS featured cadets as co-authors (Table 8). Thus, the Department's teaching through research model directly supports Army medicine through inspiring premedical cadets to pursue careers in medicine, facilitating their competitiveness for top-tier medical school admittance. See Figure 4 for a summary of the Class of 2023 medical school attendees.

Both medical and non-medical research within CLS broadly enhance problem skills and strengthen medical school applications. By design, departmental research is often multidisciplinary or interdisciplinary due to the innate overlap of chemical and biological sciences with engineering. Research within CLS generally supports the Army in one of four areas: Materials, Protection, Energy, and Leadership, with efforts frequently bridging these areas (Figure 5). As an example of non-medical research, a collaboration on metal organic frameworks features two different research groups in CLS and one with the DEVCOM CBC. This research focuses on developing new materials for the purpose of chemical warfare agent degradation or a hasty gas mask. Additionally, CLS has long-term partnerships with DEVCOM Army Research Laboratories and DEVCOM Armaments Center for evaluating energy systems modeling, energy storage, and batteries. This research has gained partnerships with both the Sustainable Infrastructure, Resilience, and Climate Consortium and Special Operations Command (SOCOM), spanning both Energy and Protection. As an example of medical research, CLS has collaborated with USU's 4D Bio^3 Laboratory on developing new biomaterials for military medical applications and protection. The Department also works closely with DTRA on microbiological research, exploring detection and therapeutic options against Bacillus

Table 7. Cadet nationally competitive undergraduate and graduate scholarship winners with CLS affiliation, 2019 – 2023

	2019	2020	2021	2022	2023
Medical school attendance	19	20	15	15	16
Rhodes scholar	0	0	0	1	0
Undergraduate scholarships	2	3	9	7	6
Graduate scholarships	5	6	3	9	4

Undergraduate – Stamps, Goldwater, Truman

Graduate – National Science Foundation, GEM fellowship, Rotary, Lincoln Labs, Draper, Fulbright, Southampton, Purdue Military Research Institute

Table 8. CLS peer-reviewed publications, 2018 – 2022

	2018	2019	2020	2021	2022	Total
Total Publications	25	40	51	53	37	206
w/Cadet Co-Authors	6	9	14	19	13	61
%Cadet Co-Authors	24.0%	22.5%	27.5%	35.8%	35.1%	29.6%

anthracis and multidrug resistant organisms. Finally, CLS cadets and faculty study biomarkers related to ACL injuries as part of a clinical study with KACH and other stakeholders.

CLS AND THE FUTURE OF ARMY MEDICINE

In conclusion, the Department of Chemistry and Life Science at West Point contributes to Army medicine on multiple time scales through scientific and leader development. In the near term, graduates immediately serve in the Medical Service Corps; in the mid-term, graduates completing their medical training serve as Army physicians and AMEDD officers return to the force from West Point faculty assignments; in the long term, both graduates and faculty alum contribute as AMEDD senior leaders. This pipeline of talent results from the synergy between academic courses, laboratory research, summer internships, club activities, and the Premedical Scholarship Program, all preparing cadets and faculty to solve the Army's most demanding medical challenges. Teaching through research serves as the integrating activity that holistically leverages these synergistic activities to provide a competitive edge, not only for medical school admission, but for a career of AMEDD service. With the continued evolution of military medical care and geo-political threat landscape driving operations, West Point provides a unique and critical role in supporting Army medicine no matter what the future may bring.

References

1. Wickiser JK, O'Donovan K, Washington M, Hummel S, Burpo FJ. Engineered pathogens and unnatural biological weapons: the future threat of synthetic biology. *CTC Sentine*l. 2020;13(8):1-7.
2. Hummel S, Burpo FJ, Hershfield J, Kick A, O'Donovan K, Barnhill J. A new age of bioterror: anticipating exploitation of tunable viral agents. *CTC Sentinel*. 2022;15(4):1-6.
3. Kick A, Hummel S, Gettings M, Bowers P, Burpo FJ. Army Officer Corps science, technology, engineering and mathematics (STEM) foundation gaps place countering weapons of mass destruction (CWMD) operations at risk – Part 1. *CWMD Journal.* 2021;23:88-94.
4. Kick A, Hummel S, Gettings M, Bowers P, Burpo FJ. Army Officer Corps science, technology, engineering and mathematics (STEM) foundation gaps place countering weapons of mass destruction (CWMD) operations at risk – Part 2. *CWMD Journal.* 2022;24:33-41.
5. Lagasse B, Bowers P, Kick A, et al. Army Officer Corps science, technology, engineering and mathematics (STEM) foundation gaps place countering weapons of mass destruction (CWMD) operations at risk – Part 3. *CWMD Journal.* July 2023.
6. Burpo FJ. Organizational adaptive capacity: how much, how fast and how often. *Defense Technical Information Center* (DTIC). 2012:1-23.
7. Burpo FJ. The great captains of chaos: developing adaptive leaders. *Mil Rev.* 2006;86(1):64-70.
8. Professional education and training programs of the Army Medical Department. Army Regulation 351-3. Washington, DC: Department of Army; 2007.
9. A century of lawmaking for a new nation: U.S. congressional documents and debates, 1774 - 1875. Accessed July 27, 2023. https://memory.loc.gov/cgi-bin/ampage
10. Chemistry & life science | United States Military Academy West Point. Accessed June 18, 2023. https://www.westpoint.edu/academics/academic-departments/chemistry-and-life-science
11. Burpo J, Comitz RL, Hummel SG. USMA Department of Chemistry and Life Science - reaction center for Army intellectual capital. January 1, 2018.
12. Burpo FJ, Hummel SG. West Point Department of Chemistry and Life Science: nexus of Army nuclear, chemical, and biological intellectual capital. August 7, 2018.
13. U.S. Army Medical Command | MEDCOM. Accessed June 18, 2023. https://www.army.mil/armymedicine#org-about
14. Blakeslee DM. West pointers lead the way to military medicine: a story of courage and commitment. *West Point Magazine*. 2013;Winter:52.
15. Program for medical, osteopathic, dental, and veterinary education for Army officers. Army Regulation 601-112. Washington, DC: Department of Army; 1972.
16. U.S. Army Health Professions Scholarship, Financial Assistance, and Active Duty Health Professions Loan Repayment Programs. Army Regulation 601-141. Washington, DC: Department of Army; 2006.
17. Core competencies for entering medical students | AAMC. Accessed June 18, 2023. https://www.aamc.org/services/admissions-lifecycle/competencies-entering-medical-students
18. Distinguished Graduate Award - West Point Association of Graduates. Accessed June 18, 2023. https://www.westpointaog.org/traditions/wpaog-awards/distinguished-graduate-award/
19. Message from the Secretary of the Army to the Force | Article | The United States Army. Accessed June 18, 2023. https://www.army.mil/article/253814/message_from_the_secretary_of_the_army_to_the_force
20. Bauer KW, Bennett JS. Alumni perceptions used to assess undergraduate research experience. *J Higher Educ.* 2003;74(2):210-230. doi:10.1080/00221546.2003.11777197
21. Zydney AL, Bennett JS, Shahid A, Bauer KW. Faculty perspectives regarding the undergraduate research experience in science and engineering. *J Eng Educ*. 2002;91(3):291-297. doi:10.1002/j.2168-9830.2002.tb00706.x
22. Little C. Undergraduate research as a student engagement springboard: exploring the longer-term reported benefits of participation in a research

conference. *Educ Res*. 2020;62(2):229-245. doi:10.1080/00131881.2020.1747360

23. Russell SH, Hancock MP, McCullough J. Benefits of undergraduate research experiences. *Science*. 2007;316(5824):548-549. doi:10.1126/science.1140384
24. The influence of on-campus, academic year undergraduate research on STEM PhD outcomes: evidence from the Meyerhoff Scholarship Program. *Educ Eval Policy Anal*. 2009;31(4):441-462. doi:10.3102/0162373709348584
25. Eagan MK, Hurtado S, Chang MJ, Garcia GA, Herrera FA, Garibay JC. Making a difference in science education: the impact of undergraduate research programs. *Am Educ Res J*. 2013;50(4):683-713. doi:10.3102/0002831213482038
26. Mass-Hernández LM, Acevedo-Aguilar LM, Lozada-Martínez ID, et al. Undergraduate research in medicine: a summary of the evidence on problems, solutions and outcomes. *Ann Med Surg (Lond)*. 2022;74:103280. doi:10.1016/j.amsu.2022.103280
27. Cooper KM, Gin LE, Akeeh B, et al. Factors that predict life sciences student persistence in undergraduate research experiences. *PLoS ONE*. 2019;14(8). doi:10.1371/journal.pone.0220186
28. Wilson AE, Pollock JL, Billick I, et al. Assessing science training programs: structured undergraduate research programs make a difference. *Bioscience*. 2018;68(7):529-534. doi:10.1093/biosci/biy052

Military Psychiatry Operational Simulation Exercise (MPOSE): A Novel Teaching Curriculum

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INTRODUCTION

In medical education, the use of simulation exercises has grown in popularity due to demonstrated effectiveness in teaching specific skill sets. In psychiatry and behavioral health curricula, the most common simulation exercises are built around behavioral emergencies. These include practicing the management of patient elopement emergencies, verbal de-escalation, and restraints training. It may also include medical emergencies such as neuroleptic malignant syndrome, serotonin syndrome, and alcohol withdrawal.[1] Military GME simulations can provide a valuable learning experience within the realms of leadership development and communication skills, and for honing hands-on procedural skills. [2, 3] Military psychiatrists require specific knowledge and skills when supporting military organizations, both in garrison and in deployed/operational settings.[4]

At any given time, about 25% of military physicians are enrolled in a Military (GME) training program.[5] These training programs represent a significant investment of financial resources, energy, and skill[5]–all to ensure a continuous supply of capable military doctors. Besides mastering the science and art of a medical specialty, a military physician must be prepared to provide care in deployed/austere environments, including under the threat of combat. Additionally, certain specialties require additional training in managing military-relevant ”signature” conditions such as post-traumatic stress disorder (PTSD), blast injuries, and Traumatic Brain Injury (TBI).[6,7] Every military physician must also learn to faithfully balance their dual role as an advocate for individual patients and the needs of the commanders and the military mission.

Training military physicians requires a deliberate approach to teaching pertinent Knowledge, Skills, Attitudes, Abilites, and Attributes (KSA3). A military GME program ideally imparts not only knowledge and skills, but also helps GME trainees develop their military officer identity and bearing. This is a unique training challenge.[8] Both of these attributes are conveyed through verbal and non-verbal communication. The resulting social intelligence helps strengthen trust between military physicians, patients, and commanders. The military physician must be able to communicate their credibility of competence, the benevolence of motives, integrity, and predictability of behaviors.[9]

To understand the parallel roles that a physician-officer must fill, one can consider the principles of pediatric practice as an analogy. The mantra in pediatrics is to deliver both patient and family-centered care. Interpersonal communication with both the child and the child’s caregiver is paramount; strong therapeutic alliance with both parties improves outcomes and care. Similarly, eliciting the most optimal advocacy from commanders is necessary. Hence, a military psychiatrist graduating from their GME program must have the KSA3 and appropriate emotional and social intelligence to earn the trust of not only their patients but also commanders.

Our residency program organizes the KSA3’s under Officership skills, Clinical Readiness Competencies, Operational Psychiatry, and Leadership/Administrative skills (see Table 1). The medium that enables these capabilities is interpersonal communication skills. These skills must be flexible, as they are needed within the military psychiatrist-commander dyad when discussing an individual patient; at the population level when advising unit commanders on the behavioral health aspects of force readiness; and in the deployed setting.

To strengthen our military unique curricula, the program wanted to enhance the communication skills in these areas. However, no curriculum existed. Here we describe the curriculum development process and its outcomes in the NCC Psychiatry residency program at Walter Reed National Military Medical Center. As part of a comprehensive and longitudinal operational curriculum for the residents, a 3-case simulation exercise was created as a high-fidelity experiential capstone–the Military Psychiatry Operational Simulation Exercise (MPOSE). We provide our experience with MPOSE from the academic years 2020-2021, and 2021-2022. This curricula can be easily adapted in other military GME programs.

METHODS:

The curriculum was designed using Kern’s 6-step process.[10]

Step 1: Problem identification and general needs assessment:

A needs assessment was conducted via an electronic survey of recent graduates of the NCC psychiatry residency training program, specifically to assess where deficiencies in the MUC may exist. Specific qualitative data was obtained that

Table 1: National Capital Consortium (NCC) Psychiatry Residency Program's Military Unique Curriculum (MUC). The Military Psychiatry Operational Simulation Exercise (MPOSE) contributes to all the MUC domains

Domains	Knowledge	Skills	Attitudes
Officership	• Lectures on officer evaluations	• Author officer evaluations • Author military awards • Military Psychiatry Operational Simulation Exercise (MPOSE)- command meeting and briefing	• Ongoing military cultural modeling by faculty
Operational Psychiatry	• Traumatic Event Management course • Combat Operational Stress Control course • Operational psychiatry rotation reading assignments	• MPOSE Combat Operational Stress Reaction (COSR) case • Operational psychiatry rotation • BH Pulse Tool execution	• Modeling by division and unit psychiatrist modeling during operational psychiatry rotation
Clinical Readiness Competencies	• Quarterly didactics on duty limitations, medical boards, and administrative separations • Clinical rotations at Military Treatment Facilities (MTF) • Didactics	• Submit duty limitation profiles, medical boards, and administrative separation packets • MPOSE duty limitations discussion	• Case conferences with emphasis on readiness and faculty modeling
Administtrative & Leadership	• MPOSE- command decisional brief • Courses: Leading Organizational Change	• Being a Service Chief rotation • Leadership and Professional Development with program director • Transition to Practice Course • Quality Improvement curriculum	• Operational Psychiatry rotation leadership reading assignments • Leadership modeling by service chiefs and faculty

thematically clustered into skills related to officership, clinical readiness, operational skills, and administrative/leadership skills. These became the four core domains of our MUC (Table 1). All surveys were developed based on expert guidance by Gehlbach et. al.[11] Additionally, a relevant literature search was conducted that demonstrated a clear need for an operational curriculum targeting military-specific competencies that are adaptable for wartime and peacetime[4,6,7,8], as well as simulation as a valuable teaching tool for military and medical curricula.[1,2,3]

Step 2: Targeted needs assessment:

The skills within these four thematic domains were mapped to pre-existing curricula (i.e. "being a service chief" was mapped to a pre-existing clinical rotation). The remaining skills were screened to see if simulation might be a good teaching modality to train with. The following skills were identified and incorporated into the simulation curricula: "command risk communication", "traumatic event management", and "combat operational stress control". These were identified as ideal for case-based curriculum development. Elements of other skills ("military medical policies", "unit BH needs assessment") were also identified and incorporated, as simulation was deemed to be an excellent way to consolidate earlier lecture-based learning content through the direct application of knowledge in a simulated case.

Step 3: Goals and objectives:

Three broad categories of cases were created: individual Service Member's health concerns, population-level health concerns, and operational/deployed psychiatry. Three unique simulation cases were developed de novo, each containing specific operational learning objectives nested under each of the three categories. All cases were written and built around real-world scenarios solicited from faculty with operational/deployed experience. These cases were then refined with feedback from WRNMMC Simulation Center Staff.

Step 4: Educational strategies:

Case #1 involved discussing the care and disposition of a 25-year-old Soldier with suicidality and alcohol dependence with his/her commander. It required learners to have the knowledge of commander's exception to Health Insurance Portability and Accountability Act (HIPAA). They were asked to fluently communicate recommendations in writing (via a DA 38-2212, which is a standardized behavioral health report for commanders) and in verbal discussion, as well as comment on impact to unit/mission.

Case #2 involved briefing a commander in accordance with guidelines on the topic of reducing driving-under-the-influence (DUI) events within a division. Learners were provided with notional unit population data,

research, and statistics and given a PowerPoint skeletonized template. They were asked to fill out the PowerPoint template and deliver a decisional brief with at least 3 feasible courses of action (COA's) and an overall recommendation.

Case #3 involved evaluating a Sailor with a Combat and Operational Stress Reaction (COSR) and a concussion following an aviation accident on a US Navy ship. In addition to direct traumatic exposure, the simulated sailor (played by a standardized patient) had also suffered a potential concussion. Learners were asked to provide behavioral health support and empathy in an interview informed by Combat Operational Stress Control (COSC)[13] principles to promote Post-Traumatic Growth (PTG). They were also asked to evaluate for a concussion using the Military Acute Concussion Evaluation (MACE-2)[14] and use this tool along with their interview to identify an appropriate disposition for this sailor, who was fulfilling an integral duty in the aftermath of this tragic accident.

Step 5: Implementation

Military commanders and those with command experience were recruited to role play for the cases involving commanders or command representatives (Case 1 and Case 2). The faculty graders were active duty or prior-service military psychiatrists who were recruited to evaluate learner performance and provide exercise feedback. All feedback provided was formative only and no grades were recorded, nor was there any sort of pass-fail standard. NCC Psychiatry is a joint residency program with both Army and Navy trainees. Therefore, Case #1 and Case #2 were US Army centered, while Case#3 was US Navy centered. All participating parties provided feedback to the learners, and all learners participated in all 3 cases regardless of which branch they belonged to.

For Case 3, the WRNMMC Simulation Center, using its funds, hired Standardized Patients (SPs) for Case 3. The SPs were provided the scenarios with suggestions for their character's role play. Both the commanders and the psychiatry faculty members received asynchronous instructions via a video, and were also provided instructions upon arrival to the simulation facility. The residents received a preparation lecture where they were educated on the mechanics of the exercise and provided resources to review to assist in strengthening their prerequisite knowledge on the topics. These included the military technical documents and manuals relevant to each case, as well as a video that modeled the command decision brief.

The simulation exercise was conducted over two days in the WRNMMC simulation center, and learners were assessed on their knowledge and confidence related to each specific simulation case before and after participating in the exercise.

A total of 33 residents in their second, third, or fourth year of psychiatry residency training participated in the academic year 2020-2021 and 26 trainees participated in the academic year 2021-2022. The modular nature of simulation exercises allows for iteration in implementation year-over-year; data can be analyzed to direct case modifcation in subsequent years - this is discussed further in the discussion section. Data presented in this article in the tables below represent only that from the initial year of simulation, 2020-2021. The three cases assessed learner confidence across a total of 14 specific military skills using a Likert scale. The same survey asked for "before MPOSE" and "after MPOSE" confidence questions and therefore all responses were paired. The data was analyzed using SPSS.[15] The paired t-tests were used to assess whether changes in mean confidence levels were statistically significant. We defined statistical significance as $p<.05$. We also used SPSS15 to calculate Cohen's d to report effect sizes. By convention, $.2<d<.5$ denotes a small effect, $.5<d<.8$ represents a moderate effect, and $d>.8$ represents a large effect.

Step 6: Evaluating the effectiveness of the curriculum

The effectiveness of the curriculum is done via exit survey by all learners. The results are provided below. Both qualitative data (free-text written feedback requesting general commentary on the overall simulation experience) and quantitative data were gathered; the qualitative data were used in real-time to improve the learning experience and were primarily logistical in nature. For example, if the first group of learners noted that text reminders would have been helpful the day of, then these were incorporated with the next day's group. However, no immediate changes were made regarding substantive case content as this might bias data received from learners on later dates. Additional quality control to this end including instructing the learners who participated first to not discuss the experience until all learners had completed the exercise. Other logistical feedback was incorporated into the following year's iteration—for example, increasing the duration of time for breaks in between cases to provide buffer time in case of delays. By contrast, quantitative data focused on measuring changes in learner confidence before and after the exercise, and is the focus of our research into the demonstrated effectiveness of this curricula.

Results: Across 14 learning objectives, 11 showed a statistically significant change in self-reported learner confidence after participation in the MPOSE. The results for Case 1, 2, and 3 are provided in Tables 2, 3 and 4 respectively. Overall, Case 2 and Case 3 demonstrated a more robust and significant increase in learner confidence as compared to Case 1. This is explored further in discussion below.

Table 2: Perceived change in the confidence levels of learners when communicating an individual Soldier suicide risk with commanders.

Outcome Areas	Mean	N	SD	SE (mean)	*t*	Significance (2-tailed)	Effect Size
Confidence in completing DA 3822 (Mental Status Exam Form)					-1.502	.143	0.32
Before Training	3.76	33	.830	.145			
After Training	4.06	33	1.088	.189			
Confidence in engaging commander to discuss individual duty limitations					-4.049	.000	0.47
Before Training	3.37	59	.869	.113			
After Training	3.81	59	.991	.129			
Confidence in engaging a commander to discuss treatment recommendations					-4.619	.000	0.54
Before Training	3.42	59	.835	.109			
After Training	3.92	59	.970	.126			
Confidence in engaging a command to discuss suicide risk mitigation					-4.548	.000	0.50
Before Training	3.46	59	.877	.114			
After Training	3.92	59	.952	.124			
Confidence with the constraints of HIPAA exceptions for commanders					-2.177	.034	0.32
Before Training	3.47	59	.935	.122			
After Training	3.80	59	1.047	.136			
Confidence in managing conflict with a commander					-4.712	.000	0.49
Before Training	3.19	59	.937	.122			
After Training	3.66	59	.993	.129			

DISCUSSION:

The value of military GME is well described elsewhere.[5] The authors highlight the top-notch nature of military GME, including board examination pass rate exceeding civilian counterparts, and being less costly than the alternatives.[5] The greatest value of military GME is that these programs teach unique KSAs required of military doctors. Psychiatry is one of the Critical Wartime Specialties (CWS) and military psychiatry GME programs must be prepared to provide the appropriate KSAs to prepare its trainees for wartime service.

The MPOSE curriculum showcases immediate improvements in learners' confidence levels in KSAs that are relevant to medical readiness (Cases 1 and 2) and wartime service (Case 3).

For Case 1, the initial year's MPOSE included completing a specific Mental Status Exam form (DA 3822). However, the pre- and post-confidence levels were not statistically significant (Table 2). This is likely because the pre-MPOSE baseline confidence mean was very high. It suggested to us that this is low-value activity and was eliminated from the subsequent iteration of MPOSE the following academic year. The effect sizes were very robust except for HIPAA-related exceptions. This is likely due to a good baseline (pre-MPOSE) knowledge and understanding of the learners. This is consistent with learners' clinical exposure to command meetings and the liaison role, as command meetings are mandatory for all hospitalized active duty patients on our inpatient unit.

The commander's decisional brief (Case 2) resulted in robust effect sizes that were larger than those seen for Case 1. This is because the baseline confidence levels were extremely low. It suggests that this case provided one of the greatest values to the learners in acquiring new KSAs.

The third case (Case 3) also shows excellent effect sizes, especially the MACE-2-based concussion assessment. However, this was removed due to feedback that the time to conduct concussion assessment, in addition to COSR, was insufficient.

Some of the benefits of the simulation experience are difficult to capture numerically but were overwhelmingly noted in subjective written feedback. Overall, learners reported highly valuing the individualized feedback from the commanders who drew on real-life experiences to give broader advice on how best to help Service Members and commanders alike. Several commanders noted how beneficial training like this would have been for behavioral health professionals they had known and with whom they had worked previously. Other constructive feedback regarding logistics, timing, and case reference materials was collected and has already been implemented in developing three new cases and another iteration of MPOSE, which is projected to become an annual training exercise for the program. The modular design of these cases means the educational content can and should be adapted to meet the specific needs of each generation of the learners.

During the design and implementation of the MPOSE,

Table 3: Perceived change in the confidence levels of learners when communicating a population-level concern with commanders via a commander's decisional brief.

Outcome Areas	Mean	N	SD	SE (mean)	*t*	Significance (2-tailed)	Effect Size
Confidence in creating slides for a commander's brief					-4.841	.000	0.71
Before Training	2.71	59	1.068	.139			
After Training	3.41	59	0.912	.119			
Confidence in presenting a high-quality commander's brief					-6.387	.000	0.73
Before Training	2.63	59	.963	.125			
After Training	3.32	59	.937	.122			
Confidence in providing population-level interventions to a commander					-5.560	.000	0.69
Before Training	2.59	59	1.069	.139			
After Training	3.31	59	1.021	.133			
Confidence in conducting a commander's decisional brief					-5.820	.000	0.72
Before Training	2.64	59	1.047	.136			
After Training	3.37	59	.981	.128			

there were several challenges. The size of the residency program is very large. This resulted in excluding the first-year trainees. Despite this, the remaining number of trainees were split into two separate half-days. Each of these events was still very long and the faculty and commanders' feedback was to somehow shorten these half-day events. Another challenge was recruiting commanders or ex-commanders for the role play. Each half-day event required nine faculty and six commanders or ex-commanders to run the MPOSE. Due to difficulty with recruitment, some stations were provisioned with non-commissioned officers (NCOs) as command representatives in place of commanders which is a common real-world occurrence. In the future, we plan to use both officers (commanders) and NCOs as command representatives for Case 1.

There are also some limitations to MPOSE. While our institution can centrally fund the event, other residency programs may have to provide such funds. Additionally, the outcomes reported (Tables 2, 3, and 4) are the immediate changes in the perceived confidence level. The long-term impact of MPOSE is unknown. Finally, we plan to conduct the MPOSE on annual basis with different cases although the same learning objectives. The effect size of our outcomes may drop as the baseline means (pre-MPOSE) rise with repeated exposure to the concepts and materials. Hence, the optimal "dosing" of this curriculum is unclear, whether it should be a single exposure, annual, or of some other frequency.

Despite the aforementioned challenges and limitations, MPOSE is first of its kind simulation training for military psychiatry residents that was easy to implement and the curricular outcomes are encouraging.

Table 4: Perceived change in the confidence levels of learners when managing an individual Service Member with Combat and Operational Stress Reaction (COSR).

Outcome Areas	Mean	N	SD	SE (mean)	*t*	Significance (2-tailed)	Effect Size
Confidence in assessing concussion using MACE 2					-6.918	.000	1.14
Before Training	2.24	33	1.091	.190			
After Training	3.48	33	1.093	.190			
Confidence in gathering history in operational acute stress reaction (COSR)					-4.404	.000	0.53
Before Training	3.39	59	1.017	.132			
After Training	3.92	59	.952	.124			
Confidence in recommending duty limitations for a patient with COSR					-4.461	.000	0.59
Before Training	3.05	59	1.057	.138			
After Training	3.66	59	1.010	.132			
Confidence in managing an acute stress case in operational environment					-4.489	.000	0.56
Before Training	3.05	59	1.057	.138			
After Training	3.63	59	1.015	.132			

CONCLUSION

The use of simulation-based learning can be an effective and invaluable way to train psychiatrists and medical practitioners in military-specific domains. It allows trainees to face high-stakes scenarios in a low-stakes environment and turns a distressing scenario into one experienced with eustress.16 The MPOSE resulted in robust outcomes and effect sizes on key competencies despite some of the challenges and limitations. This curriculum can be easily adapted in other military residency programs to enhance their Military Unique Curriculu

References

1. Mitra P, Fluyau D. The current role of medical simulation in psychiatry. In: *StatPearls* [Internet]. Treasure Island, FL: *StatPearls Publishing*; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK551665/. Updated May 8, 2022.
2. Polk TM, Greer J, Alex J, Kiser R, Gunzelman K, Petersen C, Spooner M. Simulation training for operational medicine providers (STOMP): design and implementation of a novel comprehensive skills-based curriculum for military general medical officers. *Mil Med*. 2018;183(suppl_1):40-46. doi:10.1093/milmed/usx140. PMID: 29635553.
3. West JC, Woodson JT, Benedek DM. Large-scale simulation for teaching combat and operational stress control: Operation Bushmaster. *Acad Psychiatry*. 2015;39(4):398-401. doi:10.1007/s40596-015-0310-4. PMID: 25753309.
4. Curley JM, Warner CH. Maximizing the division psychiatrist's garrison prevention role to meet the U.S. Army's 21st-century readiness expectations. *Mil Med*. 2019;184(5-6). doi:10.1093/milmed/usz017.
5. True MW, Bell DG, Faux BM, Matos RI, Valdez MM, Bonjour TJ, Morris MJ. The value of military graduate medical education. *Mil Med*. 2020;185(5-6). doi:10.1093/milmed/usaa030. PMID: 32091600.
6. Warner CH. A decade of war: adapting to meet the mental health training demands. *Acad Psychiatry*. 2015;39(4):351-353. doi:10.1007/s40596-015-0365-2. PMID: 26002635.
7. Capaldi VF 2nd, Zembrzuska HD. Thrust into the breach: psychiatry in a combat zone within 1 year of residency completion. *Acad Psychiatry*. 2015;39(4):410-415. doi:10.1007/s40596-015-0283-3. PMID: 25636255.
8. Groom RM, Carr RB, Leong SL, Hornbaker-Park MB. Impact of an enduring war on two military psychiatry residency programs. *Acad Psychiatry*. 2015;39(4):354-359. doi:10.1007/s40596-015-0284-2. PMID: 25739934.
9. Allen C, Braun WG III. Trust: implications for the Army profession. Army War College Carlisle Barracks PA; October 1, 2013.
10. Robertson AC, Fowler LC, Niconchuk J, et al. Application of Kern's 6-step approach in the development of a novel anesthesiology curriculum for perioperative code status and goals of care discussions. J Educ *Perioper Med*. 2019;21(1). PMID: 31406705; PMCID: PMC6685461.
11. Gehlbach H, Brinkworth ME. Measure twice, cut down error: a process for enhancing the validity of survey scales. *Rev Gen Psychol*. 2011;15(4):380-387.
12. Army Publishing Directorate. DA-3822, report of mental status evaluation. Available from: https://armypubs.army.mil/.
13. Army Publishing Directorate. ATP 4-02.8, Ch. 4, combat and operational stress control. Available from: https://armypubs.army.mil/.
14. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Care Services; Committee on the Review of the Department of Veterans Affairs Examinations for Traumatic Brain Injury. Evaluation of the disability determination process for traumatic brain injury in veterans. Washington, DC: *National Academies Press* (US); April 10, 2019. Available from: https://www.ncbi.nlm.nih.gov/books/NBK542592/.
15. IBM SPSS Statistics for Windows [computer program]. Version 23. Armonk, NY: IBM Corp; 2013.
16. Rudland JR, Golding C, Wilkinson TJ. The stress paradox: how stress can be good for learning. *Med Educ*. 2020;54:40-45. doi:10.1111/medu.13830.

Better Wisdom Tooth Diagnosis May Improve DNBI and Medical Evactuation Rates

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ABSTRACT

Wisdom teeth are a frequent cause for Dental-Disease and Nonbattle Injuries (DNBI) and often require medical evacuation for treatment. Proper diagnosis prior to a Soldier's deployment may prevent mission interruption, reduce time lost from work and yield significant cost savings. This retrospective chart review measured concurrence of third molar diagnostic data (Caries, Pericoronitis, Pathology, Infection, and Dental Readiness Classification) amongst Army providers in 148 US Soldiers at Fort Hood, TX. The study concluded that caries and pericoronitis accounted for 37% and 13% of Class 3 non-deployable troops, respectively. 41% percent of tobacco users had caries. 58% of the population was diagnosed as DRC 3. A Cohen's Kappa of 0.04 suggested that there is no concurrence amongst Army dental providers in diagnosis of wisdom teeth. Dental providers should consider that wisdom teeth may require treatment in austere environments and prioritize care accordingly. Improved diagnosis can reduce the need to evacuate a Dental-DNBI to a dental treatment facility while on deployment.

INTRODUCTION

Wisdom teeth are a frequent cause for Dental-Disease and Nonbattle Injuries (DNBI) on deployments. Role II healthcare providers evaluated 4831 patients during a 2003 deployment to Iraq; they found that 925 patients (19%) had dental needs.1 Oral surgery (extractions) was the second most performed dental procedure during the rotation.[1]

If there is not dental support within the area of operations (AO), then Dental-DNBI often require medical evacuation for treatment. This incurs time lost from work. During a deployment of French troops to Mali, Dental Emergencies (DE) accounted for 16% of all medical evacuations and 24% of all DNBIs.[2] Soldiers were absent from their unit for an average of 10.5 days.[2] Another study of French DE in Afghanistan estimated that 78% were predictable and attributed to pre-existing pathologies.[3] Among American personnel, wisdom teeth were the second most common cause for a DE and responsible for 19% of all emergency visits during an Operation Enduring Freedom (OEF) deployment.[4] Wisdom teeth are a burden on readiness and account for 40% of all "acute dental events" while on deployment.[5]

Dental-DNBI may be prevented if proper diagnosis can be rendered prior to Soldier deployment. This study proposes key identifiers to diagnose wisdom teeth as Dental Readiness Classification (DRC) [3] and reduce provider subjectivity. Soldiers designated DRC 3 require urgent or emergency dental treatment. DRC3 Soldiers are not worldwide deployable. Uniform diagnosis will benefit the individual patient and their unit by reducing time lost from work and preventing the need for medical evacuation. Improved diagnosis could minimize the burden Dental-DNBI pose in an austere AO as well at the cost of care in an expeditionary setting.

MATERIALS AND METHODS

This study was a retrospective chart review conducted to measure concurrence in wisdom tooth DRC diagnosis. Charts were randomly selected after US Army general dentists performed routine annual examinations. The examining dentists were blinded to the investigators and project intent. The investigators conducted a chart review and patient evaluation after the initial examining dentists provided a DRC. Investigators then assigned a DRC using protocol guidelines developed for this study. Concurrence was measured between the initial DRC and the protocol DRC. The null hypothesis stated that there is concurrence amongst Army dental providers in assigning wisdom tooth (third molar) DRC.

The investigators performed independent roles and were blinded to each other. Investigator A determined patient qualification for study inclusion. Inclusion criteria included current bitewings and a panoramic radiographs, a previously assigned DRC and the presence of third molars. Investigator A recorded the following descriptive information: Age, Gender, Tobacco Use, Rank (E1-5, E6+, O1-3, O4+, WO1-5) and Component (Active Duty-AD, Army Reserves-USAR, Army National Guard-ARNG).

Investigator B interpreted the radiographs, performed a limited oral evaluation and recorded the following information: Winter's angulation, Pell and Gregory impaction, Pericoronitis, Caries, Pathology and Infection. Investigator B assigned a DRC 2 or 3 based on protocol guidelines. The protocol DRC was recorded solely for the study and did not alter patient care. Investigator B was blinded to the DRC assigned during initial examination.

The following criteria were developed to diagnose wisdom teeth as DRC 3:

Pericoronitis
Pericoronitis is an inflammation of the gingiva associated with an impacted or partially impacted third molar. Symptoms include pain, swelling and tenderness. If severe, symptoms may include fever, dysphagia, and cervical lymphadenopathy.

Caries
Caries is a progressive disease and may be associated with pain or pulpitis. Caries can occur on the fully erupted third molar and compromise the adjacent molar.

Infections
Untreated caries or pericoronitis can progress to infections. A moderate infection can compromise the airway because of associated swelling or trismus. Severe infections directly compromise the airway and vital structures.

Pathology
Impacted wisdom teeth may develop cysts and tumors. These lesions are expansile and may undermine the jaws, which can risk a pathologic fracture. Impacted third molars have also been associated with resorption of the adjacent molar.

Results
148 patients qualified for study inclusion. This comprised 458 wisdom teeth; 222 were maxillary and 236 were mandibular. 58% of the population was diagnosed as a DRC 3.

The hypothesis was tested with a Cohen's Kappa statistical analysis that measured concurrence between the initial examination DRC and protocol DRC.

The resulting kappa of 0.04 suggests there was no concurrence between examining dentists and the protocol guidelines. The null hypothesis was rejected.

The population ranged from 19 to 53 years old, with the average patient being 29 years old. 119 were male and 29 were female. The component distribution was 20.2% USAR, 27.0% AD, and 52.7% ARNG. The 18-25-year-old age group accounted for 41% of the population.

Caries was observed in 55 individuals, this accounted for 37.1% of the DRC 3 population. 48.3% of caries was recorded in fully erupted wisdom teeth. 44 of these 55 individuals with caries were in the "E1-E5" rank. 41.8% of these individuals were 18-25 years old.

Pericoronitis was observed in 19 individuals which accounted for 12.8% of the DRC 3 population. Pathology was observed in 13 individuals, accounting for 8.7% of the total DRC 3 population.

Tobacco use was categorized as "no use", "inhalational", "chewing tobacco" or "both". 26.3% of all patients used tobacco. Tobacco use was reported by 23.6% of E1-E5 and 46.6% of E6-E9. Caries was more commonly observed in tobacco users. Caries was observed in 41% of tobacco users versus 35.7% of non-tobacco users.

There were 222 maxillary wisdom teeth and 238 mandibular wisdom teeth. 59.9% of maxillary wisdom teeth were fully erupted. The most common angulation was vertical at 74.7%, followed by distoangular at 16.2%. 43.6% of mandibular wisdom teeth were fully erupted. 34.3% of mandibular teeth were recorded as partial bony impactions. The most common mandibular angulation was vertical at 58.4% followed by mesioangular at 24.1%.

DISCUSSION

Age
In our study, 41% of the Soldiers were 18 to 25 years old. A previous study estimated that 80% of patients who seek wisdom teeth removal were younger than 25 years old.[6] If patients retain wisdom teeth, they are also more likely to develop caries in the future. Another study observed that patients who were 25 years or older had more caries in third molars.[7] They estimated that 33% of young adults with fully erupted third molars could be affected by caries.[7] The likelihood of wisdom teeth developing pain and decay increase over time. Wisdom tooth removal at an early age and phase of military service may prevent future problems.

Pericoronitis
We observed pericoronitis at 12.8% of the DRC 3 population. Previous authors observed rates of pericoronitis at 19% and 17%.4,[8] A separate study found pericoronitis in 19% of their population.[9] A previous study found that 95% of pericoronitis cases involved a mandibular wisdom tooth and 81% of cases occurred in the 20- to 29-year-old age group.10 In a review of DNBI among British troops in Iraq and Afghanistan, 81% of pericoronitis cases involved a mandibular wisdom tooth.[11]

Pericoronitis is sudden and unpredictable. Combes observed that 53% of pericoronitis cases had no previous history of symptoms.[11] A previous study found that 61% of patients had no history of symptoms.[12] These authors also observed that

mandibular third molars accounted for 86% of pericoronitis cases.[12] A history of pericoronitis should be considered when a dental provider assigns a DRC.

Caries

In our study, caries accounted for 37% of the DRC 3 population. Nearly half of fully erupted wisdom teeth were decayed. Previous authors have stated that 28% of patients with an erupted wisdom tooth were affected by caries and that mandibular wisdom teeth were most affected.[13] A 4.6-year longitudinal study found that 33% of patients developed decay on 1 or more retained wisdom teeth.[14] The authors estimated that smoking contributed a two-fold increase in caries.[14] In our study, tobacco users also experienced more caries in comparison to non-tobacco users.

A 2008 review found that caries accounted for 35% of all dental emergencies or Dental-DNBI.15 Caries comprised 37% of all dental emergencies in U.S. troops deployed to Bosnia.[16] Previous authors found that caries was the most common reason for a dental emergency followed by pericoronitis.[17] It should be anticipated that nearly one-third of patients with retained wisdom teeth will develop caries and require treatment. Soldiers who smoke should be considered at a higher risk for decay.

Angulation and Impaction

In our study, vertical and mesioangular wisdom teeth comprised 82% of all mandibular third molars: 58% were vertical and 24% were mesioangular. These findings agree with previous authors who observed that vertical and mesioangular teeth accounted for 79% of cases; 67% and 12%, respectively.[10] These two angulations of mandibular wisdom teeth are most likely to develop pericoronitis. A previous study found that pericoronitis cases involved 81% of vertical and 11% mesioangular wisdom teeth.[18] Other authors recorded vertical angulation at 51% and mesioangular at 25% of all pericoronitis cases.[19] Wisdom teeth with vertical or mesioangular orientations should be considered "at risk" for developing pericoronitis.

A wisdom tooth may also compromise the adjacent or "second" molar. When a mesioangular wisdom tooth remained for more than 5 years, this prevalence increased to 30%.20 16% of second molars developed decay if adjacent to a mesioangular wisdom tooth.[20] A previous author estimated that second molars were 9 times more likely to develop decay when adjacent to a mesioangular wisdom tooth.[21] Mesioangular wisdom teeth should be considered for the risk they pose to the adjacent molar.

Cost of Care

Cost of care can be measured by treatment, time lost from work and travel. Wisdom teeth impactions were categorized with the American Dental Association (ADA) Code on Dental Procedures and Nomenclature (CDT) to provide a dollar cost value. According to the Defense Health Agency CY2020 Guidelines for Dental Procedure Codes, Surgical Procedure Codes and Dental Weighted Values, a relative value for one DWV=$100.[22] Based on surgical complexity, it could cost from $652 to $1936 to treat a patient with a full complement of four wisdom teeth.

Previous authors have measured Dental-DNBI costs by time lost from work and total dollar cost (TDC). In the OIF theater, Dental-DNBI cost the Army an estimated $1.8 Million dollars per month.[23] This averaged to $21.4 M from July 2009 to June 2010 and $21.9 M from July 2010 to June 2011.[23] The TDC was based on transportation to the dental treatment facility (DTF), Soldier's time away from their unit and fixed treatment costs. The authors also estimated that a Soldier will be gone from their unit for 3 days.[23]

While the authors did not compare ground and air medical evacuation, the incurred costs are substantial. According to the FY 2018 Department of Defense fixed wing and helicopter reimbursement rates, the UH-60 Blackhawk aircraft costs an average of $4,461 per hour.[24] The cost is likely higher when one considers crew and medical equipment. Furthermore, the use of air assets to evacuate a Dental-DNBI distracts from a more significant medical evacuation request.

Clinicians and medical planners should consider that each DRC 3 in garrison may become a Dental-DNBI in an austere environment. We must also consider the readiness of the Army components. Simecek evaluated Dental-DNBI rates for every 1,000 Soldiers in Iraq and Afghanistan. In OIF, the USAR incurred the highest Dental-DNBI at 183 per 1,000.25 In OEF, the USAR and ARNG had 129 per 1,000.25 In Afghanistan, USAR had a 51% higher risk and ARNG had a 73% higher risk of a experiencing a Dental Emergency.26 In our study, USAR and ARNG were 29.7% DRC3 and 11.5% DRC3 respectively. Additionally, our AD component had 17.6% DRC 3. These numbers illustrate the needs that exist within the USAR and ARNG.

Weaknesses of this study include the limited population size and a greater proportion of USAR and ARNG. USAR may receive less frequent dental care than AD populations and for this reason may present a greater percentage of DRC 3. Strengths include evidence-based parameters used to define a DRC 3. Additionally, the data from this study were validated when compared to previous authors. A consensus statement could be generated among the Army dental community to inform current policies on readiness.

The allocation of expeditionary dental officers should be reviewed to identify shortcomings in access to care. The forward deployment of a dentist-dental tech team is more cost effective and practical than activating medical evacuation. Future projects should more evenly distribute the active, guard and reserve components in their study population.

A prospective study could compare the effects, if any, of smoking, e-cigarettes or chewing tobacco on caries or pericoronitis.

CONCLUSION

This study observed that caries and pericoronitis are the most frequent diagnosis for a dental DRC 3. Caries and pericoronitis are also the leading causes for dental emergencies in a deployed setting[9,17] Caries was observed in 37.1% of the population, the majority of whom were E1-E5 in rank. Caries was observed more in tobacco users than non-tobacco users. Pericoronitis was observed in 12.8% of the population. Vertical and mesioangular orientations accounted for 82% of all mandibular wisdom teeth. These angulations most frequently develop pericoronitis.[10, 18, 19] The proposed DRC 3 criteria may help standardize wisdom tooth diagnosis and prioritize care which may prevent Dental Emergencies on deployments.

Wisdom teeth are the second most common dental emergency in a deployed setting. Treatment often requires medical evacuation. This study proposed DRC 3 criteria for wisdom teeth and measured concurrence among dental providers' diagnoses. DRC 3 criteria were: Caries, Pericoronitis, Pathology and Infection. If dental services are outside the AO, a Soldier may be absent from their unit for up to 10 days.[2] Loss of a Soldier not only diminishes mission resources but increases theater expenses. Historically, Dental-DNBI can cost $1.8 Million per month for treatment.[23] Dental providers and medical planners should consider the expense and the potential impact dental needs may have on future missions.

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GLOSSARY:

AAOMS: American Association of Oral and Maxillofacial Surgeons

AD: Active Duty

ADA: American Dental Association

AO: Area of Operations

ARNG: Army National Guard

Caries: A dietary, carbohydrate modified bacterial infectious disease.

CDT: Code on Dental Procedures and Nomenclature

CENTCOM: Central Command

D7140- Extraction, erupted tooth or exposed root (elevation and/or forceps removal). Includes removal of tooth structure, minor smoothing of socket bone, and closure, as necessary.

D7230- Removal of impacted tooth – partially bony. Part of crown covered by bone; requires mucoperiosteal flap elevation and bone removal.

D7240- Removal of impacted tooth-completely bony. Most or all of crown covered by bone; requires mucoperiosteal flap elevation and bone removal.

DHA: Defense Health Agency

DNBI: Disease and Non-battle Injury

DRC: Dental Readiness Classification

DRC2: DRC 2 indicates a current dental exam and non-urgent treatment needs which are unlikely to result in a DE within 12 months. Soldiers with DRC1 and DRC 2 are considered worldwide deployable.

DRC3: DRC 3 indicates a Soldier requires urgent or emergency dental treatment. DRC3 Soldiers are not worldwide deployable.

Horizontal: The angulation of the tooth where the roots and crown are on the same horizontal plane.

Pathology: Deals with the nature, identification, and management of diseases affecting the oral and maxillofacial regions.

Pericoronitis: Defined as inflammation of the gingiva associated with an impacted or partially impacted third molar. Symptoms include pain, swelling and tenderness at the site. Severe pericoronitis may also include fever, dysphagia, lymphadenopathy, limited opening, and an unpleasant breath/taste. Purulence is a common finding

Periodontal Disease: An inflammatory disease that affects the soft and hard structures that support the teeth. Bone and teeth may be lost depending on the extent of disease progression.

OEF: Operation Enduring Freedom

OIF: Operation Iraqi Freedom

SM: Service member

Tobacco Use: "Smoking" described inhalational tobacco use, which included cigarettes, cigars, e-cigarettes, vaping or hookahs. "Chewing tobacco" described snuff, loose leaf, pouches or any noncombustible tobacco product

USAR: United States Army Reserves

References

1. Murray C, et al. Spectrum of care provided at an echelon II medical unit during Operation Iraqi Freedom. *Mil Med.* 2005;170(6):516-520.
2. Gunepin M, Derache F, Blatteau J, et al. Medical evacuation of French forces for dental emergencies: Operation Serval. *Mil Med.* 2015;180(5):578-581.
3. Gunepin M, Derache F, Ausset I, Berlizot P, et al. The rate of dental emergencies in French Armed Forces deployed to Afghanistan. *Mil Med.* 2011;176(7):828-832.
4. Dunn WJ. Dental emergency rates at an expeditionary medical support facility supporting Operation Enduring Freedom. *Mil Med.* 2004;169(5):349-353.
5. Lloro V, Lozano-de Luaces V, Lloro I, Manzanares MC. The incidence of dental needs during isolated missions compared to non-isolated missions: A systematic review and implications for future prevention strategies. *Mil Med.* 2019;184(3-4):148-155.
6. Slade GD, Foy SP, Shugars DA, et al. The impact of third molar symptoms, pain, and swelling on oral health-related quality of life. J Oral Maxillofac Surg. 2004;62:1118.
7. Shugars DA, Jacks MT, White RP Jr, et al. Occlusal caries experience in patients with asymptomatic third molars. J Oral Maxillofac Surg. 2004;62:973.
8. Mahoney G, Coombs M. A literature review of dental casualty rates. *Mil Med.* 2000;165:751-756.
9. Moss D. Dental emergencies during SFOR 8 in Bosnia. *Mil Med.* 2002;167(11):904-906.
10. Nitzan DW, Tla O, Sela MN, et al. Pericoronitis: a reappraisal of its clinical and microbiologic aspects. *J Oral Maxillofac Surg.* 1985;43:510-516.
11. Combes J, McColl E, Cross B, et al. Third molar-related morbidity in deployed service personnel. Br Dent J. 2010;209
12. Breeze J, Gibbons AJ. Are soldiers at increased risk of third molar symptoms when on operational tour in Iraq? A prospective cohort study. *JR Army Med Corps.* 2007;153(2):102-104.
13. Divaris K, Fisher E, Shugars D, et al. Risk factors for third molar occlusal caries: a longitudinal clinical investigation. *J Oral Maxillofac Surg.* 2012;70:1771.
14. Chaffin J, Moss D. Review of current U.S. Army dental emergency rates. *Mil Med.* 2008;173(1):23-26.
15. Chaffin J, King J, Fretwell D. U.S. Army dental emergency rates in Bosnia. *Mil Med.* 2001;166(12):1074-1078.
16. Dunn W, Langsten R, et al. Dental emergency rates at two expeditionary medical support facilities supporting Operations Enduring and Iraqi Freedom. *Mil Med.* 2004;169(7):510-514.
17. Halverson B, Anderson WH. The mandibular third molar position as a predictive criteria for risk for pericoronitis: a retrospective study. *Mil Med.* 1992;157(3):142-145.
18. Yamahk K, Bozkaya S. The predictivity of mandibular third molar position as a risk indicator for pericoronitis. *Clin Oral Invest.* 2008;12:9-14.
19. Pepper T, Grimshaw P, Konarzewski T, et al. Retrospective analysis of the prevalence and incidence of caries in the distal surface of mandibular second molars in British military personnel. Br J Oral Maxillofac Surg. 2017;55(2):160-163.
20. Allen RT, Witherow H, Collyer J, et al. The mesioangular third molar—to extract or not extract? Analysis of 776 consecutive third molars. Br Dent J. 2009;206; discussion 586-587.
21. Defense Health Agency. CY2020 guidelines for dental procedure codes, surgical procedure codes, and dental weighted values. 2020. Available at: https://conus.dencom.army.mil/CDSHome/Home/Index/true. Accessed February 4, 2021.
22. Colthirst P, Berg R, DeNicolo P, Simecek J. Operational cost analysis of dental emergencies for deployed U.S. Army personnel during Operation Iraqi Freedom. *Mil Med.* 2013;178(4):427-431.
23. Fiscal Year (FY) 2018 Department of Defense (DoD) fixed wing and helicopter reimbursement rates. 2017. Available at: http://comptroller.defense.gov/Financial-Management/Reports/rates2018/. Accessed April 15, 2021.
24. Simecek J, Colthirst P, Wojcik B, et al. The incidence of dental disease nonbattle injuries in deployed U.S. Army personnel. *Mil Med.* 2014;179(6):666-673.
25. Wojcik B, Szeszel W, Humphrey R, et al. Risk of dental disease nonbattle injuries and severity of dental disease in deployed U.S. Army personnel. *Mil Med.* 2015;180(5):570-577.

Baseline Familiarity of the Joint Trauma System Clinical Practice Guidelines Amongst Anesthesia Providers at a Military Treatment Facility

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ABSTRACT

Background: It was speculated that a considerable gap in knowledge regarding the Joint Trauma System (JTS) Clinical Practice Guidelines (CPGs) existed, but the extent was unknown. Based on anecdotal provider experience, a lack of familiarity with the JTS CPGs was recognized among anesthesia providers at a military treatment facility (MTF). Objective: The purpose of this project was to evaluate the level of familiarity with the existence of the JTS CPGs within a MTF's anesthesia department. Methods: A pre-test was administered to 85 anesthesia providers prior to the intervention in the form of a presentation. This presentation emphasized the history and importance of the JTS CPGs to anesthesia practice and was delivered to all participants. A post-test was administered 14 to 21 days post-intervention. Results: The pre-test determined that an educational intervention was needed, and the post-test showed that the intervention provided was efficacious at increasing familiarity ($p < 0.0001$). Discussion: Baseline familiarity was greater than 60%, indicating that providers were previously exposed to the JTS content and were aware of the existence and importance of the JTS and its CPGs. However, greater than 47% had never accessed the JTS website to reference CPGs. The majority of providers that answered "yes" in reference to "I am familiar with the JTS," were anesthesiologists and certified registered nurse anesthetists (CRNAs). Over 60% of providers that answered "no" were anesthesiology residents and nurse anesthesia residents (NARs). These providers commonly have less than 5 years of experience and are minimally exposed to the JTS until they begin their employment in the military. The intervention increased familiarity to greater than 98%. However, this did not equate to an increase in access or the utilization of the JTS resources.

INTRODUCTION AND BACKGROUND

The military has spearheaded the advancement of trauma medicine through the collection of clinical data from the battlefield. Recent operational environments and complex casualty demographics from conflicts in Iraq and Afghanistan prompted the military to implement a centralized system to track patient movement, ameliorate lapses in communication, and serve as a platform for performance improvement and trauma education. The Joint Theater Trauma System (JTTS), inspired by Colonel (Ret) John Holcomb, was created in 2004 and later transitioned to the Joint Trauma System (JTS) in 2010.[1] The JTS endeavors to advance military medicine and improve patient outcomes through evidence-based practice, utilizing methods such as the creation and dissemination of clinical practice guidelines (CPGs), which have been shown to decrease mortality and improve patient outcomes.[2] The JTS CPGs are described as "statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options."[2] It is essential that all military medical providers have a didactic understanding of the JTS CPGs prior to deployment.

LITERATURE SEARCH

In order to determine the baseline familiarity of military anesthesia providers regarding the JTS and the existence of the JTS CPGs, the authors of this project conducted a search using the terms, "joint-trauma-system" and "clinical-practice-guidelines." Cumulated Index to Nursing Allied Health Literature (CINAHL) yielded 18 articles, Ovid MEDLINE yielded 130 articles, and National Institutes of Health (NIH) yielded 54 articles to total 202 results (Appendix A). The search was further specified utilizing MeSH terms for, "education," "anesthesia," and "provider." The narrowed search terms yielded a total of 82 articles between CINAHL, Ovid, and NIH. Due to the unique and specialized nature of the subject matter, many of the articles

were excluded; the JTS was mentioned as a training tool rather than investigating the level of familiarity amongst military providers. The JTS CPGs that were utilized as a reference to provide a standard of care in an austere environment were also excluded, which resulted in 24 total articles for review. These articles focused on the implementation of CPGs, education for providers, and the effectiveness of the JTS.

Ten articles were included in the body of evidence based on their emphasis on education of the JTS CPGs, compliance of the CPGs, and reference to gaps in knowledge. According to the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) evidence rating scale (Appendix B), the cumulative quality of data collection was deemed to be high quality level IV. The critical appraisals and analysis of the articles support the hypothesis that military medical providers possess an inconsistent familiarity of the JTS CPGs. The articles demonstrated recurrent themes to include evidence of variable delivery of the JTS education, disparities in compliance, and lack of documentation. Therefore, gaps in familiarity regarding the JTS CPGs are multifactorial. Although specific CPGs were not explored, it was necessary to reference the Tactical Combat Casualty Care (TCCC) CPG and the documentation CPG in order to investigate trauma medicine and performance improvement. Relevant themes such as education, leadership, and training requirements will be discussed as potential contributors to gaps in familiarity.

Tactical Combat Casualty Care within the Joint Trauma System

The TCCC CPG was written for the point-of-injury treatment of those wounded on the battlefield. The education and advancement of prehospital medicine, to include point-of-injury care, is vital to patient survivability; however, it is only one component of the JTS multi-level system. The implementation of TCCC principles to treat wounded service members (SMs) in the combat environment affects the entire continuum of care.

TCCC implementation related to the deployed anesthesia provider is complex and begins with an understanding of TCCC principles prior to deployment. "The Defense Health Board and the Assistant Secretary of Defense (ASD) for Health Affairs have recommended TCCC training, and all of the services have directed that their deploying members obtain such training."[3] As a result, the United States (US) Central Command (CENTCOM) mandated TCCC as their "pre-deployment training."[3] Additionally, the Department of Defense Instruction (DoDI) 1322.24 released on March 16, 2018, mandated TCCC as the standard for all prehospital medical care across the Department of Defense (DoD), which allowed the standardization and progression of the JTS principles.[1] An understanding of point-of-injury care can guide anesthesia providers to tailor their interventions to the standards specified within the TCCC CPG.

TCCC and the JTS CPGs have improved clinical outcomes and have become the cornerstone of deployed medicine. Jaeger and colleagues4 found that the percentage of SMs killed in action has decreased while those who died of wounds at a military treatment facility (MTF) has increased. This emphasizes the likelihood that deployed anesthesia providers will encounter a greater number of complex surgical cases and must be able to render care according to the JTS CPGs. Therefore, they are expected to possess a comprehensive knowledge of the contents within the CPGs.

Role of Documentation within the Joint Trauma System

Palm and colleagues[5] concluded that the "JTS enables evidence-based practice across the continuum of military trauma care." This is accomplished through data collection which includes stratification and evaluation of battlefield data in order to recognize statistical trends, generate research problems, and create CPGs. To date, the JTS has utilized historical data acquired from clinical documentation. In the combat environment however, charting remains inconsistent as many forms are lost or incomplete. Two functional requirements assigned to the JTS by the Defense Health Agency (DHA) are to "enable accurate and timely entry of casualty and trauma care data into the Department of Defense Trauma Registry (DoDTR) or the current DoD system of record" and to "support the timely reporting of casualty care and trauma-related metrics."6 Adherence to these metrics remains arduous when documentation is lost or incomplete. The elements of the JTS operation cycle include trauma care delivery, the DoD trauma registry, and performance improvement.[3] These items further delineate to data abstraction, data analysis, and best practice guidelines, which underscores data collection as an essential component to improving these processes.[3] Documentation is often not prioritized in the combat setting due to limited personnel, time constraints, mass casualties, and other unique challenges associated with the austere environment; nevertheless, process improvement is highly dependent on the completeness of charting. Therefore, it is imperative that anesthesia providers understand the JTS guidelines on charting and data reporting as documentation allows for improved evidence-based practices and advancements in trauma care delivery.

Education and Clinical Practice Guidelines within the Joint Trauma System

Familiarity is inextricably linked to exposure, access to resources, provision of educational training opportunities, and directives from leadership. Gaps in familiarity are therefore multifactorial in nature. Exposure to content is a crucial component of familiarity. Today's Military Health System (MHS) is composed of an all-volunteer medical force, where the majority of healthcare professionals receive training in the civilian sector[3] Therefore, a SMs' exposure to military concepts such as the JTS is likely minimal or insubstantial

until their practice begins within the military. Jager and colleagues4 found that even within military medical programs, many curricula were deficient in the delivery of operational medicine education. Another study found that "officer and enlisted leadership courses attended by senior line and medical leaders, did not provide educational training on trauma system concepts."3 Overall, exposure to the JTS concepts is inconsistent and unique to each SM.

The Institute of Medicine3 proclaimed that, "dissemination of knowledge through the medical literature is notoriously slow, taking on average up to 17 years." This is a dismal outlook to the progression of military medicine. The JTS was accepted as the trauma system for the entire US DoD in 2010,3 which included the compilation of CPGs focused on trauma care standards to be used by deployed or deploying clinicians to improve survivability, minimize variability, and improve quality of care. The slow dissemination of knowledge, coupled with the recent establishment of the JTS as the lead trauma care organization for the military, are potential contributors to gaps in familiarity of the JTS CPGs.

An extensive literature review yielded no direct articles examining provider familiarity with the JTS CPGs. A sparse number of articles mentioned a gap in familiarity amongst providers regarding the JTS CPGs as a potential contributor to the varied adherence to the guidelines. Plackett and colleages6 found that the JTS CPG adherence ranged from 41% to 90% in the evaluated surgeons. This article had two impactful statements that directly related to the familiarity of the JTS CPGs: "adherence requires an understanding of the individual guidelines" and that pre-deployment training should focus on educating the "entire team on the existence and content of the CPGs."6 Compliance relies on the entire team having familiarity of the CPGs.[6] These statements allude to a major identified theme that CPG familiarity is linked to deployment education and training. This concept, coupled with a deficiency of military training prior to entering theater, further decreases the window of opportunity for exposure to the JTS CPGs.

The vast majority of articles referred to the CPGs in the context of pre-deployment training, inferring that deployment experience directly impacts familiarity since CPG education often occurs in conjunction with pre-deployment training.[1,3,7,8] Therefore, a lack of deployment experience may contribute to the suboptimal knowledge of the JTS CPGs, which is directly linked to the lack of exposure to the CPG content. Deployment training itself was an ambiguous topic in the literature. According to Berwick and colleagues,[3] pre-deployment training was referred to as "just-in-time training." This was a pragmatic description of trauma courses held at civilian sites for a duration of two to four weeks. SMs often attend these courses within a few months of a scheduled deployment. The study found "that best practices in combat casualty care, as defined within TCCC and the JTS CPGs, have not been integrated into training courses in a systematic way."3 Despite the establishment of the JTS as a multi-service organization, pre-deployment training was not consistent between the services.[3] For example, the Air Force was the only service that required knowledge of the JTS guidelines as part of their pre-deployment training.[3]

Additionally, the clinicians' stance on deployment readiness should be considered. Gurney and colleagues7 surveyed medical personnel regarding deployment readiness. The majority of the respondents felt either averagely prepared or unprepared for their deployment.[7] One challenge in particular to the military is the lack of volume and exposure to the trauma-specific patient population. Currently in the military, the majority of healthcare-related SMs are assigned to MTFs where there is little to no exposure to trauma care since many cases are obstetric, general, or elective.[3] Also, the military has a single Level I trauma center[3] As a result, the "military is challenged with maintaining trauma readiness in both the garrison and deployed environments."9 Formal education and experience directly contribute to a provider's ability to treat trauma patients.

Familiarity is also bolstered by means of leadership buy-in, involvement, and knowledge. By 2016, the JTS was created "with the authority to establish and assume best-practice trauma care guidelines."[2] The 2017 National Defense Authorization Act (NDAA) prioritized medical force readiness which placed an emphasis on standardization of TCCC, further development of the trauma care registry, and medical education.[10] Although the JTS is an established DoD entity, Berwick and colleagues3 found the "lack of doctrinal authority limits its capacity to function as a lead agency for the military trauma system." For instance, the MHS oversees both the ASD for Health Affairs who have the authority to develop policies and the DHA who is responsible for the standardization of education and training.[3] In other words, the JTS provides best practice trauma care guidelines but cannot create policies or mandate providers to adhere to the CPGs. Therefore, leadership regarding trauma training is not standardized and inevitably complex, evidenced by the statement that the military trauma system is "unclear in its leadership structure, with no single locus of combined responsibility and authority for maintaining the readiness and ensuring the performance of military trauma care teams and the system as a whole."3

Based on qualitative reports derived from the literature, it is perceived that a gap in knowledge exists among medical providers regarding the JTS CPGs. According to Hutter and colleagues,8 "a 1995 Congressional Budget Office report found that clinical practice rendered in MTFs during peacetime failed to sufficiently prepare military providers to deliver care during wartime." In order to ensure preparedness of the medical force to deploy and support military operations, it is vital to ensure the integrity of SMs' military and medical education, medical skills, and team cohesiveness before and during missions.[8] The principal mission of the MHS is

readiness and to deliver expert healthcare in support of the full range of military operations, domestic and abroad, via a military ready force[3]

An integral component of military medicine is trauma care delivery which is dependent on familiarization of the JTS CPGs, which results in the delivery of "expert healthcare" and "military readiness." Familiarity consists of an understanding of the JTS mission, vision, and ability to access JTS resources. Based on the literature review, if a provider is familiar with the JTS, they should know that TCCC is a JTS CPG and understand the importance of documentation in its ability to drive performance improvement and the development of future CPGs. However, a gap in the JTS CPG knowledge likely remains despite the NDAA mandates to standardize TCCC, the development of the trauma registry, and the establishment of the JTS as a DoD entity. This project assessed baseline familiarity and evaluated demographics for their influence on the JTS CPG familiarity.

PROJECT AIM

The aim of this evidence-based project was to determine the baseline familiarity of the JTS and associated CPGs within the anesthesia department at a MTF. Whether anesthesia providers were knowledgeable of specific CPG content was outside the scope of the project. All military anesthesia providers are expected to maintain a baseline familiarity with the JTS CPGs to guide care in a deployed environment. Due to the nature of the subject, this project was not considered research.

OPERATIONAL DEFINITION

'Self-assessed familiarity' was determined solely by the question, "I am familiar with the JTS." 'Assessed familiarity' was evaluated by provider knowledge of the JTS vision and mission, as well as user comfort and utilization of both the JTS website and associated JTS resources. Familiarity was further specified as 'practical knowledge,' which is the pragmatic or functional utilization of knowledge. Participants were required to answer "yes" to 5 out of 7 questions to be considered to have practical knowledge.

METHODS

A pre-test and post-test were administered throughout the anesthesia department at a MTF. The population of interest included all anesthesia providers: anesthesiologists, anesthesiology residents, certified registered nurse anesthetists (CRNAs), and nurse anesthesia residents (NARs). The pre-test and post-test questionnaires were administered using a Quick Response (QR) code to ensure anonymity. A paper questionnaire was provided to personnel with connectivity issues, collected by a volunteer, and then inputted by the authors. The questionnaire consisted of 10 demographic multiple choice type questions and 18 questions measuring individual provider familiarity of the JTS using "yes", "no", "never accessed JTS", and "never deployed" answer types (Appendix C). The pre-test was provided to the anesthesia staff on various dates within a 2-week time frame. Forums consisted of lecture halls and small-group presentations. A roster was maintained to track personnel who participated in the pre-test. The pre-test was immediately followed by an educational intervention which included a presentation that familiarized anesthesia providers with the utility of the JTS CPGs and provided additional supplemental information with links to websites and various other JTS resources. The intervention provided to all anesthesia personnel reviewed the importance of the JTS history, the TCCC CPG, and the role of documentation to anesthesia austere medicine. A post-test was administered 14 to 21 days after the intervention to ensure there was adequate time to access the provided resources and to determine the efficacy of the provided intervention. The post-test also included a fill-in-the-blank question to evaluate where the anesthesia provider first learned about the JTS. A roster was maintained to attempt to ensure the same anesthesia providers who completed the pre-test also completed the post-test. However, the questionnaires were anonymized and subsequently matched analysis could not be performed. The compiled data was sent directly to a statistician in a spreadsheet format to be scored and quantified.

Question eleven (Appendix C), "I am familiar with the JTS," was used to determine self-assessed familiarity of the provider. Practical knowledge was determined by the authors utilizing 7 of the 16 assessment questions (Table 1). These 7 questions were selected based on their ability to identify practical knowledge of the JTS content and resources to include the JTS CPGs. The practical knowledge emphasized by these questions have clinical significance and were not evaluated for statistical significance. In other words, greater than 70% was necessary to deem a participant possessed practical knowledge of the JTS content that could be utilized in a clinically significant manner.

Table 1: Questions Assessing Practical Knowledge of the JTS

1. I am aware that TCCC is a JTS CPG.
2. I can find what I am looking for on the JTS website.
3. I have access to or received JTS CPGs in any format (i.e. digital, hard copy, booklet, etc.)
4. I am comfortable navigating the JTS website.
5. I am comfortable accessing the Deployed Medicine application/website.
6. Are you aware of the JTS ADVISOR resource?
7. Are you aware of the importance of documentation per JTS guidelines?

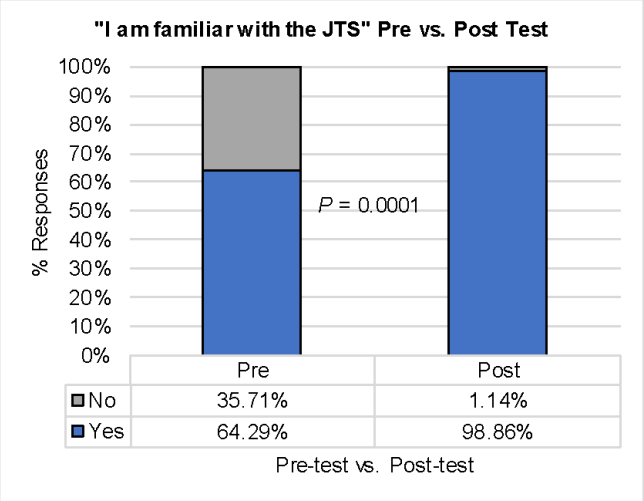
The pre-test questions were evaluated to determine where deficiencies in familiarity with the JTS existed. The pre-test data was compared to the post-test data to determine how the intervention improved familiarity and knowledge associated

with the JTS materials and resources. All data that was categorical in nature was analyzed using the Chi-Squared Test. Ordinal factors such as rank, years in service, and number of deployments were analyzed using the Kruskal-Wallis Test. All analysis was performed using JMP version 13.2 (SAS Corp, Cary, NC). Significance for tests was set using a type-1 error rate of 0.05.

RESULTS

Frequency data for demographic variables were evaluated, to include position, rank, status, and branch of service (Appendix D). Baseline self-assessment familiarity was determined using the pre-test question, "I am familiar with the Joint Trauma System." The pre-test results indicated that 64.3% of respondents stated they were familiar with the JTS, while 35.7% were unfamiliar (Figure 1). Using a Chi-Squared Test, there was a statistically significant difference ($P < 0.0001$) in familiarity between pre-test and post-test questionnaires regarding the self-assessment question, "I am familiar with the Joint Trauma System" (Figure 1).

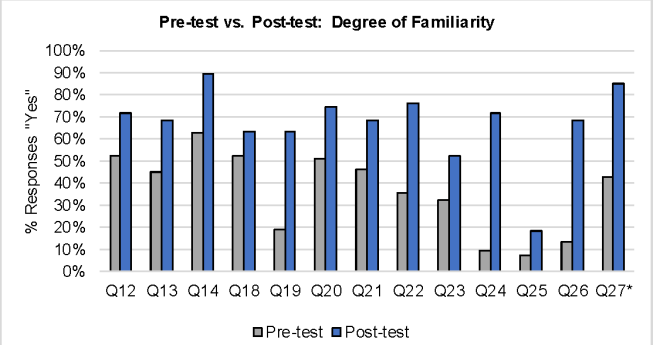
Figure 1: Pre-test vs. Post-test "I am familiar with the JTS"



Provider demographics from the pre-test were also compared with the question, "I am familiar with the JTS." The table illustrates that several demographic factors were statistically significant (Appendix E). The pre-test and post-test were then compared. There were statistically significant differences between the respondents' answers regarding awareness of the following JTS content (Appendix F): awareness of TCCC as a JTS CPG ($P < 0.001$), awareness of the JTS weekly and monthly educational conferences ($P < 0.001$), awareness of the Deployed Medicine application and website ($P < 0.001$), awareness of the JTS podcast platform ($P < 0.001$), awareness of the JTS ADVISOR resource ($P < 0.001$), and awareness of the importance of documentation per the JTS guidelines ($P < 0.001$).

Personal access of the JTS content was also investigated (Appendix F). There was a statistically significant difference in retrieval of the JTS CPGs in any format ($P = 0.001$), access of the JTS website ($P = 0.009$), access to the JTS website to reference specific CPG guidelines ($P = 0.002$), access to the Deployed Medicine application and website ($P = 0.019$), access to at least one podcast by the JTS ($P = 0.027$). Additionally, a statistically significant change was seen in provider comfort in navigating the JTS website ($P = 0.007$). The following figure illustrates the effectiveness of the intervention, depicting the pre-test and post-test results based on percentage of providers who answered "yes" (Figure 2).

Figure 2: Comparison of Pre-test vs. Post-test, Familiarity Assessment



*See Appendix C, Table 5 for a list of all the questions

DISCUSSION

Pre-test results revealed that baseline familiarity within the evaluated anesthesia department was 64.3%, while 35.7% remained unfamiliar (Table 1). This data was extrapolated from the self-assessment question, "I am familiar with the JTS." Statistically, the majority of the anesthesia department was familiar with the JTS at baseline based on the pre-test. However, many of the providers had never resourced the JTS or its CPGs (Appendix F). Regardless of the participant's answer regarding self-assessed familiarity, 47.6% of the department had never accessed the JTS website, 54.8% had never referenced specific CPGs, 81% were unaware of educational conferences and Continuing Education Unit (CEU) opportunities provided by the JTS, and 48.8% had never received the JTS CPG content in any format (Figure 2). Therefore, to address these potential discrepancies, specific questions were selected to evaluate practical knowledge of the JTS (Table 1). These identified gaps emphasize that self-assessed familiarity does not directly equate to practical knowledge of the JTS.

Providers must have a comprehensive knowledge of the JTS CPGs to provide evidence-based care in an austere environment, which is not possible if the CPGs have never been accessed or referenced. It is important to have an awareness

of the Deployed Medicine application and the weekly educational conferences provided by the JTS. The Deployed Medicine application allows providers to access the JTS CPGs without the internet, making it an indispensable resource in an austere environment. The topics discussed during weekly conferences focus on improving care in the deployed setting and emphasize relevant topics for deployed and deploying providers. The JTS Advanced Virtual Support for Operational Forces (ADVISOR) resource can be used by providers when clinical scenarios arise that are outside the scope of the provided CPGs. The JTS ADVISOR resource connects providers with subject matter experts to facilitate guidance through clinical scenarios. All of these high-yield resources were largely unknown to the anesthesia providers based on the pre-test results (Figure 2).

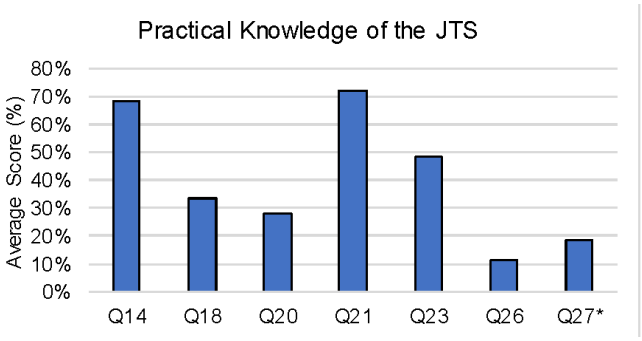
Many demographics were statistically significant which impacted how participants answered the question, "I am familiar with the JTS." These included position within the MTF, rank, and prior training courses (Appendix E). Position ($P = 0.017$) was statistically significant with 38.9% of the residents (including both NARs and anesthesiology residents) answering "yes", while 61.1% of CRNAs combined with anesthesiologists answering "yes." As such, the length of a medical officer's career also showed significance, with rank ($P = 0.001$), years in service ($P < 0.001$), and number of deployments in a medically related specialty ($P = 0.003$) directly influencing the degree of familiarity of the JTS. Those of lower rank, junior position, less deployments, and lower years in service were more likely to indicate that they were unfamiliar with the JTS as shown by the pre-test data (Appendix E).

The authors selected specific training courses that are known to incorporate JTS education, meaning that participants would have been exposed to JTS content which proved to be statistically significant ($P = 0.003$). The Advance Trauma Training Course (ATTC) and TCCC also resulted in significant data when analyzed separately, revealing that providers obtained JTS concepts during these courses. When data was evaluated, 77.6% of participants that attended at least one of these training sessions also answered "yes" in terms of JTS familiarity (Appendix E).

Based on the literature review, it was perceived that deployment experience would impact provider familiarity of the JTS. Regions of deployment ($P = 0.005$) and training prior to deployment ($P = 0.013$) were statistically significant in relation to participants answering "yes" to the question, "I am familiar with the JTS." This is a notable finding given the fact that the JTS CPGs were initially created for the CENTCOM region and have now diversified to other regions, to include garrison environments. The questionnaire revealed that, of the SMs who had deployed, 13% were unaware that the JTS existed prior to their deployments (Appendix F). In addition, independent of deployment history, 64% of the participants were unaware of the existence of the Deployed Medicine extension of the JTS, and 90% were unaware of their podcast platform (Appendix F).

The educational training provided by the authors markedly improved the JTS familiarity. The post-test questionnaire revealed that the baseline familiarity of the department increased from 64.3% to 98.9% after the intervention (Figure 1). The assessment of practical knowledge sought to assess whether providers who stated they were familiar with the JTS also possessed practical knowledge of the JTS concepts and resources (Figure 3). The pre-test comparison of practical knowledge revealed that, of the 65% of providers who stated they were familiar with the JTS, 46% scored less than 70% on the practical knowledge assessment (Table 2). In other words, despite self-assessed familiarity, they did not possess practical knowledge of the JTS concepts, which shows that providers may be exposed to the JTS content and have an awareness of the JTS and its CPGs, but may not have accessed or be comfortable navigating the JTS resources.

Figure 3: Average baseline familiarity of practical knowledge of the JTS (%) among providers who are familiar with the JTS.



*See Appendix C, Table 5 for a list of all the questions

Table 2: Comparison of practical knowledge of the JTS among those who answered "Yes" to being familiar with the JTS.

1. Total Pretest Group (N=85 # who scored <70%=55)	% Unfamiliar = 65%
2. # who answered "Yes, I am familiar with JTS (N=54) # who scored <70% = 25	% Unfamiliar = 46%

The results did not show a statistically significant increase ($P = 0.318$) in the ability to navigate the JTS website (Appendix F). The causes for this can be multifactorial. Many of the providers surveyed are residents, who have various time constraints. Other considerations may be prioritization of knowledge acquisition where providers may not access JTS material until they are confronted with a deployment.

Most participants indicated that their first encounter with the JTS was the intervention provided by this project (Table 3). It is notable that only 13% of the participants heard of the JTS as part of their pre-deployment training. In essence, although trauma resources in the form of CPGs are readily available and accessible, it has fallen on the onus of individual SMs to delve into the knowledge. This highlights the lack of standardized pre-deployment training. Based on the NDAA mandates, if a provider has deployed, they should have heard of the JTS. Many of these providers may have deployed prior to the 2018 NDAA mandate, which may contribute to the low percentage.

Table 3: Qualitative Fill-in Questions from Post-Test "Where did you first hear about the JTS?"

Category	N	%
JTS Presentation	25	32%
On-the-job Training	20	25%
Military Training	13	15%
Residency	11	14%
Deployment/Pre-Deployment Training	10	13%

Pre-deployment and trauma training often incorporates JTS principles to include CPG familiarization. However, most training does not incorporate a complete description of accessible resources, references, or instructions on the JTS functionality and the critical role it fulfills within combatant commands. Without this crucial understanding, forward-deployed providers will face obstacles in maximizing their contributions to the trauma system. Earlier exposure to the JTS may be more efficacious than pre-deployment training. Therefore, there is a need to promote the early education of the JTS's purpose, functionality, and usability of resources to ensure the self-proficiency of providers and the advancement of trauma practice. Additionally, more comprehensive training would alleviate potential knowledge gaps between individual personnel, ensuring a more uniform deployment standard across the platform.

LIMITATIONS

The limitations of this project included convenience sampling, internet connectivity, schedule conflicts, and disregard of instructions about not proceeding with the post-test if a pre-test was not completed. As a result, there were 85 pre-tests and 95 post-tests. This may have been attributed to suboptimal internet connectivity which resulted in duplicate online entries or a misunderstanding of instructions. Due to the various and fluid schedules of anesthesia personnel, multiple presentations were conducted to capture the largest sample size possible. Therefore, threats to internal validity included the potential sharing of information between anesthesia personnel who had received the intervention and those who did not, despite instructions to refrain from discussing the obtained JTS training until the entire department received the training.

CONCLUSION

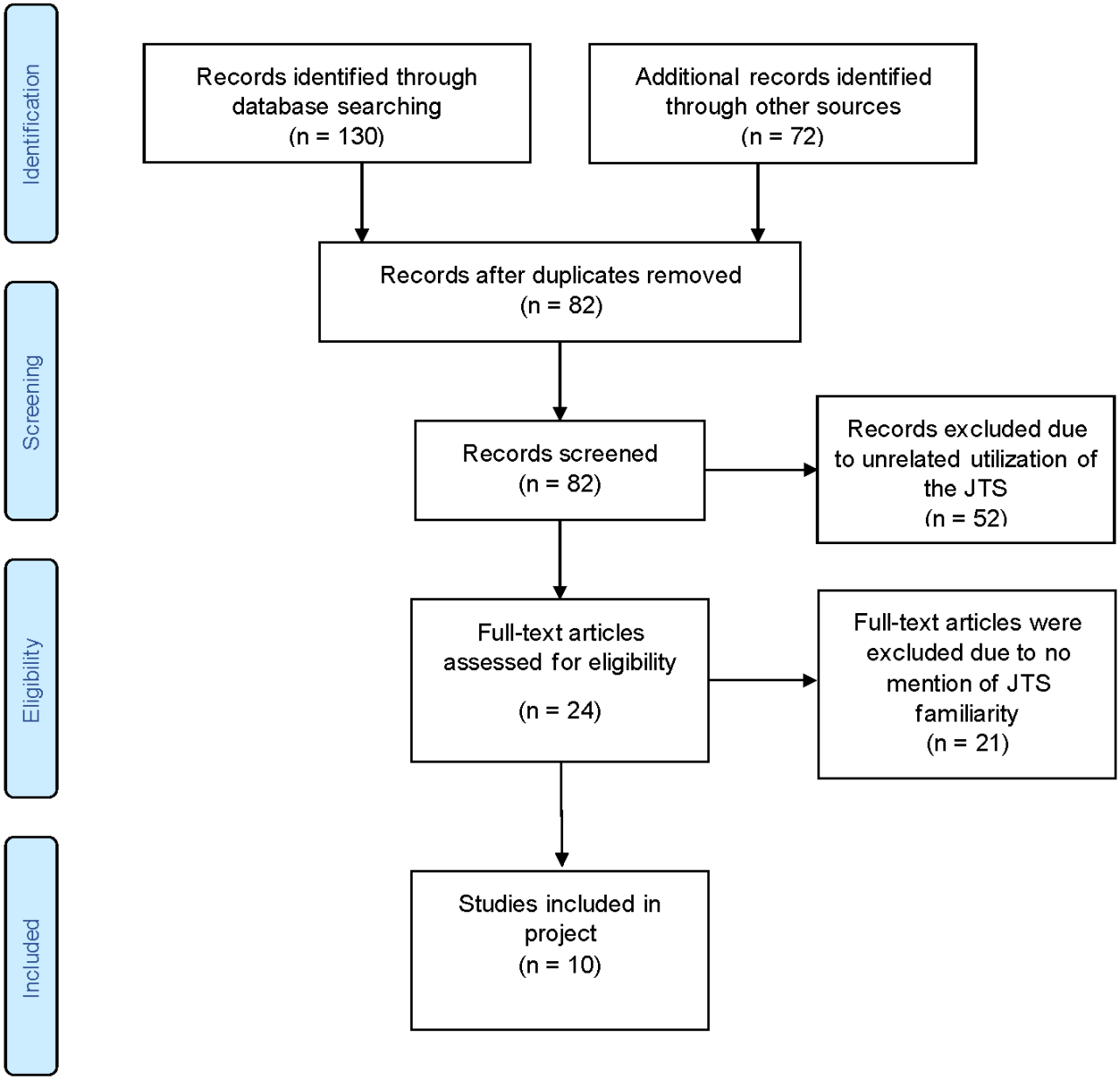
Quantitative research evaluating the knowledge gap of the JTS CPGs among anesthesia providers was non-existent in the literature review and data was sparse within the reviewed qualitative studies. However, the literature review showed discrepancies in education and training of the JTS CPGs. Numerous studies focused on providing data to indicate needed improvements in trauma care, while others recommended changes for future practices. These themes, along with continued advances in practice and technology to disseminate knowledge, showed that efforts are in place to increase familiarity with the JTS CPGs, but that a familiarity deficit remains. Based on the results of this project, the current educational efforts regarding the JTS CPGs are not sufficient. It appears that this project was the first to evaluate the baseline familiarity of anesthesia providers with the JTS. There was a lack of familiarity with the JTS CPGs within the anesthesia population evaluated. It was determined that position at the hospital, years in service, training courses attended, and deployment were statistically significant in how participants answered the question, "I am familiar with the JTS." Participants within these categories had a higher likelihood of answering "yes" regarding JTS familiarity. The intervention, which included a presentation that emphasized the importance of JTS history, the TCCC CPG, and the importance of documentation, improved familiarity within the department to greater than 98%.

RECOMMENDATIONS

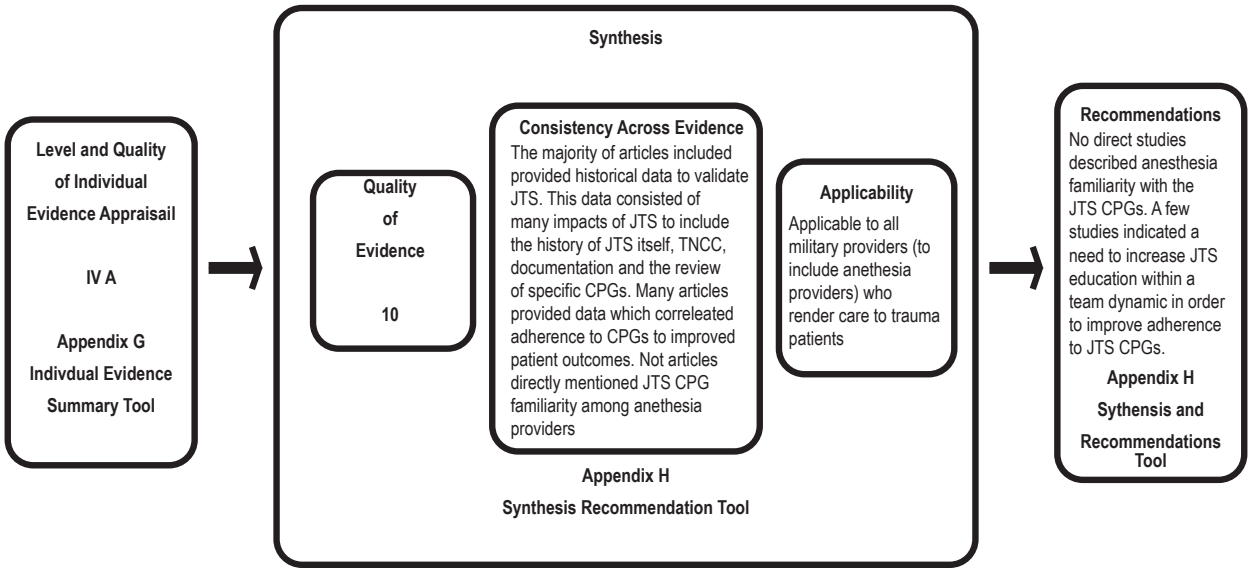
Recommendations for future research and investigation include studies with larger sample sizes at multiple MTFs. Identification of the most influential demographic data is required to create specific training to target vulnerable areas. A larger sample size is required to derive this data. This would allow the implementation of training designed to target the personnel most likely to be deficient in JTS knowledge (demographic predictors could be utilized in future studies). Obtaining names or test identification may alleviate duplicate entries and capture direct assessment of individual improvement. Knowledge of JTS principles and CPGs is not equivalent to practical knowledge and therefore should be distinguished in future studies.

Appendix A

Figure 4: PRISMA Diagram



Appendix B



Derived from material published by The Johns Hopkins Hospital/Johns Hopkins University.

Appendix C

Table 4: Baseline Familiarity of the Joint Trauma System Questionnaire - Demographics

Part 1: Demographics		
1. What is your position at Brooke Army Medical Center?	Staff Anesthesiologist ☐ Staff CRNA ☐ MD Resident ☐ Nurse Anesthesia Resident ☐	
2. What is your current rank?	O-1 ☐ O-2 ☐ O-3 ☐ O-4 ☐	O-5 ☐ O-6 ☐ Not applicable ☐
3. What is your current status at Brooke Army Medical Center?	Active Duty ☐ Reserves/National Guard ☐ Civilian/GS/VA ☐	
4. If you answered “Civilian/GS/VA,” what is your previous military service?	Retired/Discharged Officer ☐ Retired/Discharged Enlisted ☐ Never served ☐ Not applicable ☐	
5. Which branch of service have you been or are you currently associated with? (Select all that may apply)	Army ☐ Air Force ☐ Navy ☐ None of the above ☐	
6. Which training courses have you attended? (Select all that apply)	Advanced Trauma Training Course ☐ Emergency War Surgery Course ☐ Flight Medicine Course ☐ Tactical Combat Casualty Course ☐ Other (please specify) ☐ _____ None of the above ☐	
7. How many years have you served in the military as a medically related specialty?	0 - 2 years ☐ 3 - 5 years ☐ 6 - 10 years ☐ 11 - 15 years ☐	16 - 20 years ☐ >20 years ☐ Not applicable ☐
8. How many times have you deployed with a medically related specialty?	1 ☐ 2 ☐ 3 ☐ 4 ☐	5 ☐ >5 deployments ☐ Not applicable ☐
9. Did you receive any training prior to your deployment?	Yes ☐ No ☐ Not applicable ☐	
10. What was the region of your deployment? (Select all that apply)	USAFRICOM ☐ USNORTHCOM ☐ USSOUTHCOM☐ USEUCOM ☐ USINDOPACOM ☐ USCENTCOM ☐ Not applicable ☐	

Table 5: Baseline Familiarity of the JTS Questionnaire - Assessment

Part 2: Familiarity Assessment			
11. I am familiar with the Joint Trauma System (JTS).	☐ Yes	☐ No	
12. I have accessed the JTS website.	☐ Yes	☐ No	
13. I have accessed the JTS website to reference specific clinical practice guidelines (CPGs).	☐ Yes	☐ No	
14. I am aware Tactical Combat Casualty Care is a JTS CPG.	☐ Yes	☐ No	
15. I was aware that the JTS existed prior to my deployment(s).	☐ Yes	☐ No	☐ Never deployed
16. I was first introduced to the JTS during my deployment.	☐ Yes	☐ No	☐ Never deployed
17. I utilized the JTS CPGs prior to my deployment(s).	☐ Yes	☐ No	☐ Never deployed
18. I can find what I am looking for on the JTS website.	☐ Yes	☐ No	☐ Never accessed JTS
19. I am aware that the JTS has weekly and monthly educational conferences which grant CEUs.	☐ Yes	☐ No	
20. I have access to or received JTS CPGs in any format (i.e. digital, hard copy, booklet, etc)	☐ Yes	☐ No	
21. I am comfortable navigating the JTS website.	☐ Yes	☐ No	☐ Never accessed JTS
22. I am aware of the Deployed Medicine application/website.	☐ Yes	☐ No	
23. I am comfortable accessing the Deployed Medicine application/website.	☐ Yes	☐ No	☐ Never accessed Deployed Medicine
24. I am aware of the JTS podcast platform.	☐ Yes	☐ No	
25. I have listened to at least one podcast by the JTS.	☐ Yes	☐ No	
26. Are you aware of the JTS ADVISOR resource?	☐ Yes	☐ No	
27. Are you aware of the importance of documentation per JTS guidelines?	☐ Yes	☐ No	

Appendix D

Table 6: Participant Demographic Frequency

Demographic	Description	n	%
Position at Military Treatment Facility	Anesthesiologist	11	12.94
	MD Resident	38	44.71
	Staff CRNA	30	35.29
	NAR	6	7.06
Rank during time of Pre-Test	O-1	1	1.18
	O-2	3	3.53
	O-3	51	60.00
	O-4	12	14.12
	O-5	5	5.88
	O-6	2	2.35
	N/A	11	12.94
Status at Military Treatment Facility	Active Duty	71	83.53
	Reserve/NG	1	15.29
	Civilian/VA	13	1.18
Branch of Service	Army	43	50.59
	Air Force	37	43.53
	Other	3	3.53
	N/A	2	2.35

Appendix E

Table 7: Baseline Familiarity "I am familiar with the JTS" vs Demographics from Pre-test

Survey Question	Factor	Familiar with JTS		%	p-val
		Yes	No		
What is your current status?	Active Duty	44	26	62.9%	0.536
	Civilian/GS/VA/Reserve Component	10	4	71.4%	
What is your position?	MD Resident	19	19	50.0%	0.017
	Nurse Anesthesia Resident	2	3	40.0%	
	Staff Anesthesiologist	8	3	72.7%	
	Staff CRNA	25	5	83.3%	
What is your current rank?	O-2	1	1	50.0%	0.001
	O-3	27	24	52.9%	
	O-4	11	1	91.7%	
	O-5	5	0	100.0%	
	O-6	2	0	100.0%	
Branch	Air Force	24	13	64.9%	0.103
	Army	29	13	69.0%	
	Other, both or neither	1	4	20.0%	
How many years have you served in the military as a medically related specialty?	0 - 2 years	5	14	26.3%	<.001
	3 - 5 years	17	9	65.4%	
	6 - 10 years	11	3	78.6%	
	11 - 15 years	8	1	88.9%	
	16 - 20 years	8	0	100.0%	
	20 or more	5	1	83.3%	
How many times have you deployed with a medically-related specialty?	0	30	26	53.6%	0.003
	1	10	3	76.9%	
	2	8	0	100.0%	
	3	2	1	66.7%	
	4 or more	4	0	100.0%	
USCENTCOM deployment	Yes	20	3	87.0%	0.005
	No	34	27	55.7%	
Did you receive any training prior to your deployment?	Yes	23	4	66.7%	0.013
	No	4	2	52.9%	
	Not applicable	27	24	85.2%	
Have you received a training course	Yes	38	11	77.6%	0.003
	No	16	19	45.7%	
Tactical Combat Casualty Care Course	Yes	30	10	75.0%	0.049
	No	24	20	54.5%	
Advanced Trauma Training Course	Yes	23	4	85.2%	0.004
	No	31	26	54.4%	

References

1. Spott MA, Kurkowski CR, Stockinger Z. The Joint Trauma System: History in the Making. *Mil Med.* Sep 1 2018;183(suppl_2):4-7. doi:10.1093/milmed/usy166
2. Spott MA, Burelison DR, Kurkowski CR, Stockinger ZT. JTS CPG Development Process. *Mil Med.* Sep 1 2018;183(suppl_2):12-14. doi:10.1093/milmed/usy113
3. Berwick D, Downey A, Cornett E. A National Trauma Care System: Integrating Military and Civilian Trauma Systems to Achieve Zero Preventable Deaths After Injury. Committee on Military Trauma Care's Learning Health System and Its Translation to the Civilian Sector, Board on Health Sciences Policy, Board on the Health of Select Populations, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine; 2016.
4. Jaeger JM, Rice DC, Albright-Trainer B. Battlefield Medicine: Anesthesia and Critical Care in the Combat Zone. *Anesthesiol Clin*. Jun 2021;39(2):321-336. doi:10.1016/j.anclin.2021.03.002
5. Palm K, Apodaca A, Spencer D, et al. Evaluation of military trauma system practices related to complications after injury. J *Trauma Acute Care Surg.* Dec 2012;73(6 Suppl 5):S465-71. doi:10.1097/TA.0b013e31827548a9
6. Plackett TP, Cherry DC, Delk G, et al. Clinical practice guideline adherence during Operation Inherent Resolve. *J Trauma Acute Care Surg.* Jul 2017;83(1 Suppl 1):S66-S70. doi:10.1097/TA.0000000000001473
7. Gurney JM, Cole WC, Graybill JC, Shackelford SA, Via DK. Maintaining Surgical Readiness While Deployed to Low-Volume Military Treatment Facilities: A Pilot Program for Clinical and Operational Sustainment Training in the Deployed Environment. *Military Medicine*. 2020-01-07 2020;185(Supplement_1):508-512. doi:10.1093/milmed/usz263
8. Hutter PJ, Roski J, Woodson J, et al. Readiness Of Medical Providers In The Military Health System: Overview Of Operational And Policy Considerations. *Health Aff (Millwood)*. Aug 2019;38(8):1274-1280. doi:10.1377/hlthaff.2019.00336
9. Suresh MR, Valdez-Delgado KK, Staudt AM, Trevino JD, Mann-Salinas EA, Vanfosson CA. An Assessment of Pre-deployment Training for Army Nurses and Medics. *Military Medicine*. 2021-01-30 2021;186(1-2):203-211. doi:10.1093/milmed/usaa291
10. Clemente Fuentes MRW. Operational Curriculum and Research Initiatives: Shaping the Future of Military Medicine. *Fed Pract*. Oct 2021;38(10):474-482. doi:10.12788/fp.0192
11. H.R.4350 - 117th Congress (2021-2022): National Defense Authorization Act for Fiscal Year 2022. (2022, March 1). https://www.congress.gov/bill/117th-congress/house-bill/4350/text
12. DoD Instruction 1322.24, "Medical Readiness Training," March 16, 2018.
13. DoD Instruction 6040.47, "Joint Trauma System (JTS)," August 5, 2018.

Plasmodium vivax Malaria with COVID-19 Coinfection

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ABSTRACT:

The association between the SARS-CoV-2 virus and *Plasmodium vivax* malaria has not been documented in the United States. We present the case of a 27-year-old United States soldier with an active COVID-19 infection and new-onset malaria six months after returning from Korea. The patient's clinical presentation was further complicated by splenomegaly attributed to active EBV infectious mononucleosis. This case demonstrates the importance of obtaining a detailed history of a patient's fevers regardless of recent travel to identify rare pathologies and concomitant infections that a COVID-19 diagnosis may mask. We also recommend malaria prophylaxis to all patients visiting countries where malaria is prevalent. More research is necessary to establish the effects of COVID-19 on malaria and to coordinate care.

INTRODUCTION:

Plasmodium vivax (*P. vivax*) is the most widespread plasmodium species of human malarial protozoan endemic to various tropical areas worldwide including sub-Saharan Africa, Southeast Asia, and South America.[1] Transmission of *P. vivax* malaria occurs via the Anopheles mosquito and is characterized by a "tertian" paroxysmal fever recurring every 48 hours on average.[2,3] Diagnosis requires blood smears with Giemsa-stain which are used to visualize the intraerythrocytic trophozoites.[3] Due to the parasite's ability to remain dormant in the liver in its hypnozoite form, relapse may occur up to two years after infection, though incubation typically occurs between 12 and 17 days.[3] The primary treatment of vivax malaria is Chloroquine or in resistant strains Artemether/lumefantrine (Coartem), atovaquone-proguanil, quinine and doxycycline, or mefloquine. Treatment should be supplemented with Primaquine to eliminate the dormant hypnozoite phase of P. vivax thus preventing relapse.

The Center for Disease Control and Prevention (CDC) estimates that 2,000 cases of malaria are diagnosed annually in the United States (US).[4] Most of the documented cases of malaria in the US are diagnosed in individuals returning from sub-Saharan Africa and South Asia.

P. vivax malaria plagued the Korean Peninsula before its eradication in the late 1970s, however, it experienced a re-emergence in 1993 when a Korean soldier at the Demilitarized Zone (DMZ) contracted the parasite.[2] It is estimated that over 90% of malaria cases during the 1993 re-emergence occurred amongst Korean and American soldiers stationed at the DMZ. Between 1993 and 2017, 34,487 cases of vivax malaria were diagnosed in Korea though the incidence has decreased substantially since its emergence.

The SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) virus responsible for the COVID-19 pandemic that began in December 2019 may have an association with *P. vivax* malaria, however, more research is necessary to confirm this connection.[5] Many cases have been established worldwide of relapsing or severe P. vivax in individuals with COVID-19 infection though the pathophysiology behind such a phenomenon remains unknown.[6,7,8,9] Analysis of the clinical interaction between COVID-19 and *P. vivax* malaria is currently limited to case reports due in part to the lack of literature on the SARS-CoV-2 virus. Currently, there are no cases reported of patients with both *P. vivax* malaria and COVID-19 infection in the US.

Case:

A 27-year-old Caucasian male active-duty soldier from the US with no past medical history presented with body aches and fevers of 1-month duration. The patient previously reported feeling "really sick" and went to a civilian emergency department near his home of record three weeks prior where he was diagnosed with Epstein-Barr virus (EBV) infectious mononucleosis. At that time, the patient reported consistent fevers occurring between 4 PM and 10 PM every other day alongside diaphoresis. He stated the fevers had since subsided but complained of extreme fatigue, weakness, headache, sore throat, cough, shortness of breath, and joint pain in the knees, elbows, and wrist. His cough and congestion began one-week prior. The patient denied any sick contacts at home and tested negative for COVID-19 in July 2022. He denies having nausea, vomiting, or diarrhea. The patient was deployed to Korea from August 2021 to February 2022 and the authors had previously diagnosed other soldiers in his brigade with malaria. During his trip to Korea, he was frequently in wooded areas for training but denies any known mosquito bites. He also states he was vaccinated for COVID-19 twice in 2021. A review of systems was otherwise unremarkable, and he takes no medications.On admission, the patient

was afebrile (36.6-37.8 degrees Celsius), normotensive (BP 117/75), with a normal pulse (92 bpm), and respiratory rate (19 breaths/min). Oxygen saturation was 96-98% on room air. A comprehensive physical exam including HEENT, cardiovascular, respiratory, abdominal, and neurological systems was unremarkable. Laboratory testing revealed normocytic, normochromic anemia (Hgb 11.6), thrombocytopenia (platelets 127,000), and an acute kidney injury (creatinine 1.40). Urinalysis was unremarkable and liver function tests were within normal limits. SARS-CoV-2 PCR was detected on admission indicating a positive COVID-19 diagnosis. Chest x-ray showed no evidence of acute cardiac or pulmonary disease (Figure 1). Abdominal ultrasound revealed the presence of splenomegaly (Figure 2). The patient was started on a 3-day course of remdesivir (200mg IV day 1 then 100mg IV daily day 2 and 3) after his COVID-19 diagnosis.

Figure 1. AP (left) and lateral (right) chest X-rays revealing no evidence of COVID-19 pneumonia.

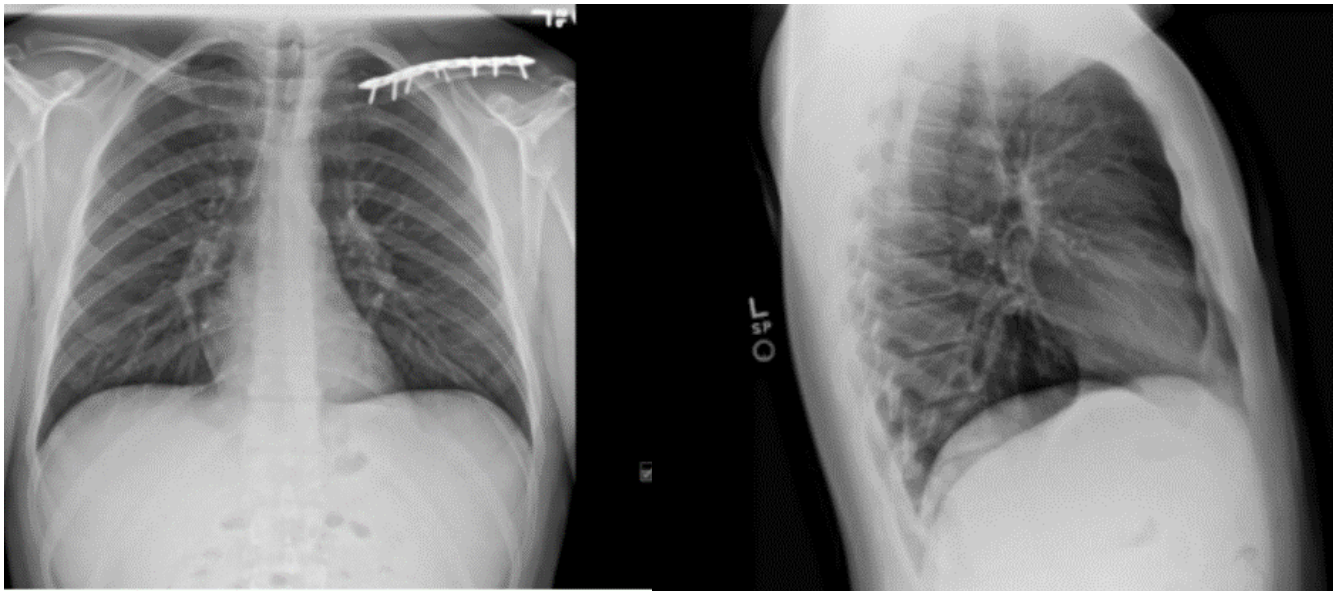

Figure 2. Abdominal ultrasound illustrating splenomegaly. The spleen volume (Spleen Vol), width (Spleen W), and height (Spleen H) are shown in the legend on the bottom left.

A peripheral smear and malaria antigen test were ordered due to suspicions of malaria given the cyclical fevers and return from Korea six months prior. Peripheral smear showed gametocytes and ring forms consistent with *P. vivax* at approximately 1,700 parasites per microliter. Results of the peripheral smear and a positive malaria antigen test confirmed the diagnosis of *P. vivax* malaria. Infectious disease was consulted, and the patient was started on artemether/lumefantrine (20mg/120mg, 4 tabs oral, BID) and primaquine (30mg, 2 tabs oral, daily) with daily complete blood counts and comprehensive metabolic panels for surveillance.

The patient's symptoms steadily improved each day after admission with repeat peripheral smears revealing reduced parasite burdens of 90 parasites per microliter on day two and 20 parasites per microliter on day three. His acute kidney injury resolved with a discharge serum creatinine of 1.1. The patient was discharged after a 4-day admission with 10 more days of primaquine. The infectious disease physician arranged for a follow-up visit six days after discharge. The patient was advised against straining, heavy lifting, or contact sports due to the splenomegaly secondary to infectious mononucleosis and told to repeat an abdominal ultrasound in 2-4 weeks to reassess.

DISCUSSION

P. vivax malaria in the US is an easily missed diagnosis due to its extremely low incidence and ability to present months to years after initial infection such as in this patient. Individuals, most notably military personnel, traveling to any country with *P. vivax* malaria should receive the appropriate prophylaxis. Additionally, we recommend that patients who experience a transient febrile illness and have traveled to countries in which *P. vivax* is endemic receive a malaria antigen test and peripheral blood smear. The differential diagnosis for febrile illness is broad and includes several other infections, thus necessitating a proper and comprehensive history from the patient to rule out other causes. Fever, chills, cough, shortness of breath, and muscle aches are all nonspecific and common symptoms applicable to both COVID-19 and malarial infections complicating the clinical presentation.[10,11] The patient's symptoms were further complicated by the presence of infectious mononucleosis, which may have caused the malaise and fever at the time of admission.[12] Focused questioning regarding the timing of a patient's fever is vital to distinguishing malaria from other more common causes of infection.

The association between mononucleosis and malaria has been well documented throughout their respective geographical distributions. One study by Moormann et al. noted an increase in the incidence of Burkitt lymphoma in patients with P. falciparum and EBV mononucleosis coinfection.[13] Additionally, there is evidence that *P. vivax* malaria infections may lead to increased EBV viral replication.[14]

In a young immunocompetent patient, both COVID-19 and infectious mononucleosis are typically self-limiting pathologies.[15] Analysis between mononucleosis and COVID by Gold et al. revealed the possibility of EBV reactivation by the SARS-CoV-2 virus.[16] Additionally, the report found that many of the symptoms attributed to COVID-19 in individuals with mononucleosis were due to EBV-induced inflammation. There is currently no literature examining the association between EBV infectious mononucleosis, COVID-19 infection, and *P. vivax* malaria.

CONCLUSION:

In conclusion, a thorough history, including travel and the nature of a patient's symptoms, is necessary to ensure rarer diagnoses such as malaria are not missed in the United States and other non-endemic regions. The standard question asking about recent travel may not suffice in these cases as initial symptoms can present several months to years after contracting the illness. Clinicians should have a high index of suspicion for malaria in all individuals with a history of cyclical fevers, including individuals without recent travel to endemic areas. These patients should be diagnosed and treated promptly to prevent further complications. With the widespread nature of COVID-19 and its broad symptomatology, a focused history and physical exam are vital to identify non-COVID pathologies in patients. Additional investigations are necessary to establish the connection and various interactions between COVID-19 and other infections including *P. vivax* malaria.

References:

1. Dayananda KK, Achur RN, Gowda DC. Epidemiology, drug resistance, and pathophysiology of Plasmodium vivax malaria. J *Vector Borne Dis.* 2018 Jan-Mar;55(1):1-8. doi: 10.4103/0972-9062.234620. PMID: 29916441; PMCID: PMC6996296.
2. Im, J.H., Kwon, H.Y., Baek, J. et al. Severe Plasmodium vivax infection in Korea. *Malar J* 16, 51 (2017). https://doi.org/10.1186/s12936-017-1684-4
3. Menkin-Smith L, Winders WT. Plasmodium Vivax Malaria. [Updated 2022 Jul 19]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK538333/
4. CDC - malaria - about malaria. Centers for Disease Control and Prevention. https://www.cdc.gov/malaria/about/index.html#:~:text=About%202%2C000%20cases%20of%20malaria,Saharan%20Africa%20and%20South%20Asia. Published February 2, 2022. Accessed August 28, 2022.
5. Shahid Z, Karim N, Shahid F, Yousaf Z. COVID-19 Associated Imported Plasmodium vivax Malaria Relapse: First Reported Case and Literature Review. *Res Rep Trop Med*. 2021 May 10;12:77-80. doi: 10.2147/RRTM.S292157. PMID: 34007238; PMCID: PMC8121982.

6. Anyanwu MU. The association between malaria prevalence and COVID-19 mortality. *BMC Infect Dis*. 2021 Sep 19;21(1):975. doi: 10.1186/s12879-021-06701-8. PMID: 34538242; PMCID: PMC8449890.

7. Bahk YY, Lee HW, Na BK, Kim J, Jin K, Hong YS, Kim TS. Epidemiological Characteristics of Re-emerging Vivax Malaria in the Republic of Korea (1993-2017). *Korean J Parasitol*. 2018 Dec;56(6):531-543. doi: 10.3347/kjp.2018.56.6.531. Epub 2018 Dec 31. PMID: 30630273; PMCID: PMC6327199.

8. Sardar S, Sharma R, Alyamani TYM, Aboukamar M. COVID-19 and Plasmodium vivax malaria co-infection. *IDCases*. 2020 Jun 20;21:e00879. doi: 10.1016/j.idcr.2020.e00879. PMID: 32665888; PMCID: PMC7305490.

9. Boonyarangka, P.; Phontham, K.; Sriwichai, S.; Poramathikul, K.; Harncharoenkul, K.; Kuntawunginn, W.; Maneesrikhum, N.; Srisawath, S.; Seenuan, C.; Thanyakait, C.; et al. Co-Infection with Plasmodium vivax and COVID-19 in *Thailand. Trop. Med. Infect. Dis.* 2022, 7, 145. https://doi.org/10.3390/ tropicalmed7080145

10. Alimohamadi Y, Sepandi M, Taghdir M, Hosamirudsari H. Determine the most common clinical symptoms in COVID-19 patients: a systematic review and meta-analysis. *J Prev Med Hyg*. 2020 Oct 6;61(3):E304-E312. doi: 10.15167/2421-4248/jpmh2020.61.3.1530. PMID: 33150219; PMCID: PMC7595075.

11. Trampuz A, Jereb M, Muzlovic I, Prabhu RM. Clinical review: Severe malaria. *Crit Care*. 2003 Aug;7(4):315-23. doi: 10.1186/cc2183. Epub 2003 Apr 14. PMID: 12930555; PMCID: PMC270697.

12. Balfour HH Jr, Dunmire SK, Hogquist KA. Infectious mononucleosis. *Clin Transl Immunology*. 2015 Feb 27;4(2):e33. doi: 10.1038/cti.2015.1. PMID: 25774295; PMCID: PMC4346501.

13. Moormann AM, Snider CJ, Chelimo K. The company malaria keeps: how co-infection with Epstein-Barr virus leads to endemic Burkitt lymphoma. C*urr Opin Infect Dis*. 2011 Oct;24(5):435-41. doi: 10.1097/QCO.0b013e328349ac4f. PMID: 21885920; PMCID: PMC3265160.

14. Akin F, Kocaoglu C, Solak ES, Ozdemir H, Pektas B, Arslan S. Coinfection of Plasmodium vivax and Epstein-Barr virus: case report. *Asian Pac J Trop Dis*. 2013 Feb;3(1):74–5. doi: 10.1016/S2222-1808(13)60016-X. PMCID: PMC4027255.

15. Min K, Lee JK. Infectious Mononucleosis Complicated With COVID-19. *Pediatr Infect Dis J*. 2022 Jul 1;41(7):e301. doi: 10.1097/INF.0000000000003535. Epub 2022 Jun 7. PMID: 35389945; PMCID: PMC9177126.

16. Gold JE, Okyay RA, Licht WE, Hurley DJ. Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation. *Pathogens*. 2021 Jun 17;10(6):763. doi: 10.3390/pathogens10060763. PMID: 34204243; PMCID: PMC8233978.

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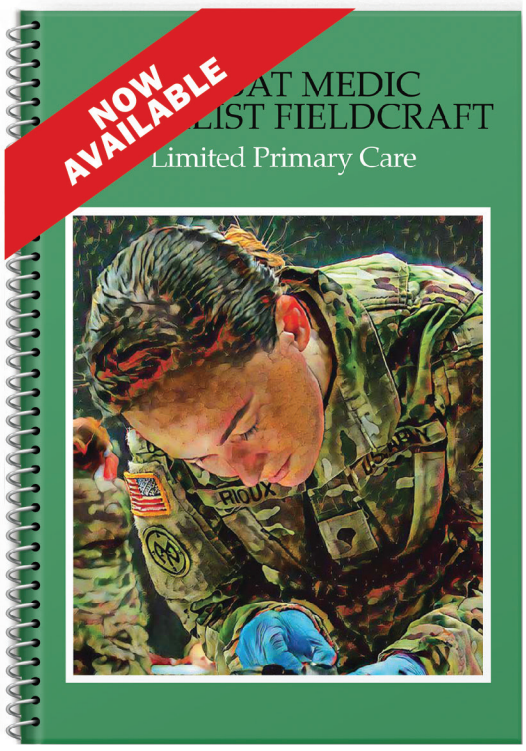

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Pathways and Partnerships to Support the All-Volunteer Military Medicine Force

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ABSTRACT

Current recruitment strategies for building the all-volunteer force have largely focused on increasing eligibility. Less focus has been on increasing the propensity for service. The GI Bill provides social mobility with programs in educational assistance, housing assistance and job training. The Uniformed Services University (USU), America's Medical School, is a model for recruiting efforts that expand pathways for certification and degrees. USU's School of Medicine and Enlisted to Medical Degree Preparatory Program are tuition-free pathways in which students receive full pay and benefits while attending school. In addition to these programs, USU internships for high school and undergraduate students provide economic and/or academic support for those interested in technical specialties. Individuals are also able to connect through the Military Medical Ambassador (MMA) program to those military members currently in STEM fields. Additional recruiting efforts to modernize processes to reduce administrative burden, reduce barriers to information sharing, and prioritize resources to support modern family structures would further facilitate entry into STEM fields. These solutions can apply to many difficult-to-fill technical specialties, i.e. cyber, engineering, and information technology, across the Department of Defense (DOD), thus increasing the propensity for service and investing in continued upward social mobility.

MANUSCRIPT

Building the all-volunteer force relies on successful recruiting of individuals to meet critical wartime tasks. Two fundamental recruiting approaches are increasing eligibility and increasing the propensity to serve. Methods by which eligibility could be increased have been discussed at length, including addressing medical standards related to the increased prescribing of mental health medications and difficulties obtaining a security clearance because of prior marijuana use. There has been less focus on increasing the propensity to serve, warranting consideration. Three main methods exist: expanding pathways for obtaining certifications and degrees, modernizing recruiting accession processes and incentives, and prioritizing resources to support modern family structures. This paper will address these methods using the accessions process for military medicine at Uniformed Services University (USU), America's Medical School, as model for recruiting efforts that could be more broadly applied across the Department of Defense (DoD).

For many, consideration of military service begins with career aspirations for upward social mobility. Regardless of whether individuals enlist or commission, educational assistance is the most tangible benefit to secure a better future. The GI Bill has been one of the most significant sources of economic mobility over the last 75 years because of the education, housing, and job training provided. Though the GI Bill was transformative, Black veterans experienced significant physical and societal barriers to utilizing its benefits, with one study demonstrating Black veterans' cash equivalent value of the GI Bill was 70% of that for white veterans.[1] For many technical specialties, like medicine, a high bar to entry can prevent career pursuit, particularly for individuals with fewer means and personal networks. Applying to medical school requires an undergraduate degree with a GPA above a 3.0, completion of the Medical College Admissions Test (MCAT), rigorous premedical coursework, a minimum of 100 hours of clinical work and/or shadowing, as well as exposure to service or research. A report from 2018 found that 75% of medical students come from the upper two quartiles of wealth.2 Applicants from more modest means may be unable to afford to volunteer or shadow a physician for hundreds of hours because they must work to support themselves or their families. Students who do not obtain the required GPA need to enroll in postbaccalaureate programs to become eligible candidates. Success on entrance exams like the MCAT often require costly test preparation courses. Many students must retake the exam to obtain a competitive score with a fee associated for each exam. In addition, applying to medical school requires a fee per school (USU is free) with most applicants needing to apply to over 10 schools to obtain admission; also required are 4 to 8 letters of recommendation, with at least one from a physician.

In contrast to civilian medical schools, medical students attending USU receive pay and benefits while serving as an active duty second lieutenant or ensign in return for 7 years of service. USU has created a pathway program called the Enlisted to Medical Degree Preparatory Program (EMDP2) that allows 25 of the highest performing servicemembers to remain on active duty and complete a 2-year postbaccalaureate program to complete the required coursework, MCAT test

preparation, and dedicated shadowing and mentorship from military physicians.3 This program serves as a model for supporting highly specialized certifications and degrees. The military needs to expand pathway programs like EMDP2 that provide financial support, test preparation, and professional networks, though they do not have to be as resource intensive as the EMDP2 program to have impact. Other examples include paying for test preparation and application fees as well expanding civilian summer internship experiences within the DoD that assist in preparation and application for competitive degree programs. Some examples include the CHAMP research program for undergraduate and graduate-level students or the USU Comprehensive Student Research Training Program for high-school and college students.4 In addition, the Oak Ridge Institute for Science and Education (ORISE) STEM program at USU allows high-school and college students to gain much needed research experience.5 DoD partnerships for paid internships give exposure to the unique military career opportunities and access to role models, mentors, and advisers that encourage and inspire service. It is critical these pathways are widely available agnostic of rank and military occupation. An institutional commitment to varied and comprehensive pathways for individual career development will both retain the most talented servicemembers and encourage civilians to pursue a career in the military by allowing access to highly sought after career fields. Many similar programs already exist in the DoD but are not well known or marketed. Promoting military-civilian internships and degree programs can change the public narrative surrounding military service as a means for pursuing careers in science, technology, engineering, and math (STEM) rather than resulting in wounded warriors.

To market military service as an entryway into STEM fields, recruiting processes must be modernized to reduce the administrative burden and bureaucratic stove piping preventing information sharing. With the overarching goal of building a capable force, information systems which collect accessions data must enable lead sharing, or the ability to share a potential recruit's information with the most appropriate recruiting entity, across the services. Regardless of the method that an individual comes into the military, recruiting requires a whole-of-government approach to provide access to as many career fields as possible. USU has medical students from the Air Force, Army, Navy, Public Health Service, and Coast Guard. USU consistently works with recruiters for the Health Professions Scholarship Program (HPSP), which provides medical school tuition and a stipend at a civilian program in return for 4 years of service. Application for these two programs differs with students applying to USU through the American Medical College Application Service (AMCAS) and to the HPSP program through the recruiter. Systems engineering and information technology that allow applicants to simultaneously apply to both programs would reduce unnecessary redundancy and applicant burden. Applicants also want to be able to speak with military personnel who currently work in their intended career field. USU's Military Medical Ambassador (MMA) program connects military physicians with applicants to answer questions about USU and military medicine.6 Recruiting must be streamlined to reduce the frustrations, red tape, and potential loss of qualified candidates. Current practices are burdensome from a time, effort, and cost perspective, often requiring the applicant to take leave to complete the required clearances, turn in forms repetitively, have intricate knowledge of the accession system to experience success, and personally cobble together essential information to make an informed decision. An efficient recruiting system, and recruiters who are intimately familiar with the accession requirements, process, and future job duties of the recruit, are necessary for success. Lastly, recruiting incentives must align with a whole-of-government approach regardless of the military occupation and branch of service. Recruiters must be enabled to work closely with human resources professionals across the military and civilian federal services to recruit specialized skills sets and retain vital military experience. Individually aligned recruiting incentives generate an unnecessary zero-sum game between recruiters for the same population. Recruiting networks with access to a single information system should be formed through partnerships across the military and federal civilian sector.

Many potential solutions for recruiting military physicians also apply to efforts directed at difficult-to-fill technical specialties like cyber, engineering, and information technology. Highly technical skillsets generally provide higher salaries in the private sector. To build this cadre of specialists requires the DoD provide a direct pathway for an educational benefit and appeal to the unique mission, leadership skill development, and camaraderie provided through military service. Pathways and partnerships to improve recruiting must include the servicemember and their family. As a values-based organization, the DoD must expand initiatives to support childcare and spousal employment to maintain the balance between service and sacrifice. 61.3% of the active-duty force has children.7 Medicine and the military often have 24-hour or extended hour job requirements that necessitate access to expanded childcare hours. Official partnerships should be considered for nanny and au pair services in addition to daycare to ease the burden of finding childcare, particularly for dual professional and single parent households. The military parental leave policy that supports both birthing and non-birthing parents provides a substantial benefit that makes military service more attractive.8 The dependent care flexible spending account is an additional new benefit, which should be easier to elect at any time.9 As with tuition assistance programs, programs that support military families can be space-limited, difficult to access, and too time consuming to fully utilize. Half of active-duty service members are married with 64% of spouses employed outside the home.10 Additional consideration needs to be made for assignments that accommodate spousal employment in federal

facilities, particularly in OCONUS and remote locations. Expansion of tuition assistance for spousal professional development and degree programs would further the narrative of military service as a means for career advancement. One possibility is prioritization of portable certifications and degree programs in areas with national shortages, such as nursing and medical technicians; spouses could then be preferentially employed at military treatment facilities. Following in the spirit of the GI Bill, the military has the opportunity to increase the propensity to serve by doing more of what the DoD already does: investing in the upward mobility and development of our people and their families.

The opinions and assertions expressed herein are those of the author(s) and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences, The Henry Jackson Foundation for the Advancement of Military Medicine, the Department of Defense, or other Federal Agencies.

References

1. Meschede T, Eden M, Jain S, et al. IERE Research Brief: Final Report for our GI Bill Study. Brandeis University. Dec 2022. Available URL: https://heller.brandeis.edu/iere/pdfs/racial-wealth-equity/racial-wealth-gap/gi-bill-final-report.pdf.
2. Youngclaus J, Roskovensky L. Analysis in Brief: An Updated Look at the Economic Diversity of U.S. Medical Students. Association of American Medical Colleges. Oct 2018. Available URL: https://www.aamc.org/data-reports/analysis-brief/report/updated-look-economic-diversity-us-medical-students
3. Uniformed Services University. Providing Opportunities for Enlisted Members. Accessed Jan 5, 2024. Available URL: https://medschool.usuhs.edu/academics/emdp2
4. Uniformed Services University. Consortium for Health and Military Performance (CHAMP): Internship. Accessed Jan 5, 2024. Available URL: https://champ.usuhs.edu/about/internship.
5. Oak Ridge Institute for Science and Education (ORISE). STEM Internships and Fellowships. Accessed Jan 5, 2024. Available URL: https://orise.orau.gov/internships-fellowships/index.html.
6. Uniformed Services University. Military Medical Ambassadors. Accessed Jan 5, 2024. Available URL: https://medschool.usuhs.edu/resources
7. Military One Source. Chapter 5: Active-Duty Families in 2022 Demographics. Accessed Jan 5, 2024. Available URL: https://demographics.militaryonesource.mil/chapter-5-active-duty-families
8. Military One Source. Taking Care of Our People: Military Parental Leave Policy. Accessed Jan 5, 2024. Available URL: https://download.militaryonesource.mil/12038/MOS/Factsheets/tcop/TCOP-Factsheet-ParentalLeave.pdf
9. Military One Source. Dependent Care Flexible Spending Account. Accessed Jan 5, 2024. Available URL: https://www.militaryonesource.mil/benefits/dependent-fsa/
10. U.S. Department of Defense. 2021 Demographics: Profile of the Military Community. Accessed Jan 5, 2025. Available URL: https://download.militaryonesource.mil/12038/MOS/Reports/2021-demographics-report.pdf

Evaluation of Insecticide Treated Military Uniforms in Combination with DoD Approved Insect Repellents Against Sand Fly Bites Using a Hairless Guinea Pig Model

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ABSTRACT

Sand flies are small, blood feeding arthropods responsible for the transmission of *Leishmania* protozoa, the causative agent of Leishmaniasis which can affect humans. This study evaluated the efficacy of permethrin-treated, etofenprox-treated, and untreated Flame-Resistant Army Combat Uniform (FRACU) materials, in preventing sand fly, *Phlebotomus papatasi,* bites when challenged in the absence or presence of military authorized topical repellents i. e. diethyl-m-toluamide -DEET, Ethyl butylacetylaminoproprionate commonly referred to as Insect Repellent 3535-IR3535, and picaridin, when applied to the exposed skin of hairless guinea pigs. Uniform fabrics used in sand fly bite challenges were exposed to 1, 20, and 50 washes prior to the start of this study. Our findings demonstrate the hairless guinea pig as a suitable animal model that supports sand fly host-seeking behavior and could replace the use of humans in treated uniform bite protection studies. Probing was not recorded; however, the presence or absence of blood was examined 24 hours after exposure by crushing the sand fly on white filter paper. Statistically significant differences were observed in the percentage of blood fed sand flies between untreated and both treated uniforms (etofenprox and permethrin). However, no significant difference was found between number of wash treatments. Bite protection was observed when topical repellents (DEET, Picaridin, and IR355) were applied to the host exposed skin. The trends observed in sand fly knockdown (above 60% at 1h) vary with multiple wash treatments suggesting that sand flies were potentially in contact with treated uniforms even in the presence of topical repellents. Also, a synergistic effect (treated uniform and repellents) should be considered. This assessment highlights the bite protection offered by military treated uniforms and repellents against sand fly bites and disease transmission. Therefore, the use of topical repellents along with treated uniforms remains highly recommended.

INTRODUCTION

Vector-borne pathogens (VBP) are threats transmitted by the bite of a variety of blood feeding arthropods, including sand flies, to civilian and military populations. Bite protection remains the primary safeguard as vaccines and therapeutics are only available for a limited number of vector-borne diseases (VBD). Global U.S. military deployments to high-risk VBD areas have severe consequences on Soldiers' health, impacting their operational readiness. Furthermore, service members are disproportionately impacted by VBD due to the nature of their work, often in field environments for training and deployment operations. The global mobilization of U.S. military personnel often requires deployments of large contingencies across numerous diverse environments. Hence, VBD threats carry potentially epidemic consequences. Thus, protection efforts represent a top priority for physical readiness and mission success.

The Department of Defense (DoD) insect repellent system consisting of insecticide-treated uniforms and bed nets, topical repellents, and proper wear of uniforms is an effective way of preventing arthropod bites. Proper use of permethrin-treated uniforms and the topical repellent DEET have been documented to show a reduction in the number of insect bites[1,2.] Although DEET is considered the gold standard for repelling insect vectors[3], other repellents such as IR3535 and picaridin are acceptable alternatives for military use.[4] However, in some parts of the world where service members deploy, the DoD repellent system is often inhibited by the development of resistance to permethrin, the active ingredient used for treatment of military uniforms and bed nets.[5] Moreover, user compliance of bed nets, proper wear of treated uniforms, and application of topical repellents on exposed skin is sometimes a challenge.[5] Personal protective measures (PPM) recommended by the Armed Forces Pest Management Board must be continuously developed to better protect the Warfighters in an ever-changing operational environment.5 This requires periodic evaluation and

re-evaluation of PPM effectiveness to guide modifications and inclusion of novel protective materials and advise Force Health Protection authorities. For example, recently the military authorized the use of a second EPA-approved synthetic pyrethroid-like compound, etofenprox for treating uniforms.

Sand flies, (Diptera: Psychodidae, Phlebotominae) are small, hairy, pool-feeding hematophagous insects capable of transmitting diseases to humans. The subfamily Phlebotominae includes *two genera (Phlebotomus and Lutzomyia)* with members geographically distributed in the Old and New World, respectively. Some sand fly species are highly anthropophilic (prefer human blood) while others prefer feeding on animal blood (mammals, reptiles, and birds). Sand flies are known to transmit several species of *Leishmania* parasites, sand fly fever virus, and *Bartonella bacteria to humans.* Though well studied in mosquitoes, the protective value of insecticide-treated fabrics against competent sand fly vectors around the world remains poorly investigated. Previous studies evaluating the efficacy of DEET, IR3535, and picaridin against *Phlebotomus papatasi* showed complete protection in humans[7,8]. However, these studies did not evaluate these repellents in the presence of insecticide-treated materials.[6]

The effectiveness of permethrin-treated uniforms to prevent sand fly bites was previously evaluated using human volunteers. The uniforms were composed of cotton/nylon blends and were treated with permethrin using individual dynamic absorption (IDA) kits, two-gallon sprayers, aerosol cans, or were factory treated[2,9]. However, these uniforms are no longer used in the U.S. military.

Here, we investigated bite prevention against *Phlebotomus papatasi* (North Sinai strain), one of the most competent vectors of *Leishmania major* in the Old World. This vector has broad geographic distribution throughout Europe, Northern Africa, and the Middle East.[10,5] The uniform materials tested in this study are composed of 65% Rayon/25% Para-Aramid/10% Nylon. This study is unique in the use of treated FRACU (Flame Resistant Army Combat Uniform) material in accordance with MIL-PRF-32636, Type III, Class 1 (flame resistant cloth, ripstop) with operational camouflage pattern (OCP) that is impregnated with permethrin or etofenprox. The hairless guinea pig model was chosen for this study due to previous success working with sand flies and hairless guinea pigs. Buchta et al. 2015, demonstrated that hairless guinea pigs were an attractive host to *Phlebotomus papatasi* and provided high blood feeding rates.[11] The aim of the current study was to evaluate the effectiveness of permethrin-treated, etofenprox-treated, and untreated U.S. military uniform sample material in protecting against sand fly bites with or without topical repellents applied to guinea pigs' exposed skin. We hypothesized that sand fly bites will be statistically reduced when treated uniforms in conjunction with topical repellent is utilized compared to the untreated uniform with no repellent.

MATERIALS AND METHODS

Study design

Permethrin-treated, etofenprox-treated, and untreated FRACUs, in combination with and without topical repellents (DEET, IR3535, and picaridin) were used to evaluate bite protection against *P. papatasi* sand flies, using a hairless guinea pig model. Efficacy was assessed after FRACUs were washed 1, 20, and 50 times.

Uniform samples

FRACU material was procured and cut into 182.88 X 76.2 cm pieces. Those pieces were folded and sewn on three sides to create a 91.44 X 76.2 cm "pillowcase" samples to better represent a uniform versus flat material. The samples were then sent to be factory treated with permethrin or etofenprox. All material swatches used in this study were provided by the Textile Materials Evaluation Team at the Combat Development Command-Soldier Center located in Natick, MA.. A set of 7.62cm diameter samples from each treated uniform material (permethrin or etofenprox) was cut and submitted to gas chromatography-mass spectrometry (GC-MS) analysis to determine the concentration levels of the active insecticide ingredient for each group. This measurement was assessed before washing and after 1, 20, and 50 washes. Material not meeting the minimum or exceeding the maximum (0.181 mg/cm^{2}- $^{0.2}$66 mg/cm^{2} for etofenprox and 0.095 mg/cm^{2}-0.140 mg/cm^{2} for permethrin) required active ingredient at the no wash timepoint, were excluded from this study. The material not meeting the minimum 0.025 mg/cm^{2} and maximum 0.140mg/cm^{2} required concentration of permethrin at the 20x washes were not used for this study. There are no requirements for 1x and 50x requirements for permethrin, and there are no requirements for 1x, 20x, and 50x for etofenprox.

Sand flies

All sand flies were reared in the insectary at Walter Reed Army Institute of Research (WRAIR) using methods described by Lawyer et. al 2017[12]. Sand flies were three to five-day old, nulliparous, non-infective female *Phlebotomus papatasi* originating from North Sinai, Egypt. The sand flies were housed in an environmental chamber with conditions of 26℃ and 80% relative humidity with a photoperiod of 12-hour light:12-hour dark. Sand flies were maintained with a 30% sucrose solution soaked in cotton pad ad libitum. Sixteen hours prior to the start of experiments the sugar pad was removed.

Animals

Hairless guinea pigs (*Cavia porcellus Linnaeus*) were chosen as the animal model for this study because of their attractiveness to feeding sand flies, ease of handling, and large skin surface area that provides adequate space to apply repellent and for partial coverage with uniform material. The study was conducted according to an approved Institutional Animal Care and Use Committee (IACUC) animal use research protocol. Thirty (30) female guinea pigs were obtained from the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD). Animals ranged in age from approximately 8-11 months and were greater than 400 grams each. Animal health reports, provided by USAMRICD, included negative results for Lymphocytic Choriomeningitis Virus, Sendai virus, Pneumonia virus (PVM), Reovirus 1,2,3, Guinea pig adenovirus, Simian Virus 5, Encephalitozoon cuniculi, Guinea pig Cytomegalovirus, *Clostridium piliform*, and *Bordetella bronchiseptica*. At the WRAIR animal facility, guinea pigs were socially housed with enrichment, fed with LabDiet 5025 Guinea Pig Diet with a photoperiod of 12-hour light:12-hour dark. Because hairless guinea pigs have sensitivity to varying environmental conditions, the room was maintained at temperature and humidity ranging from 23.3-25°C and 30-70% humidity (RH), respectively.

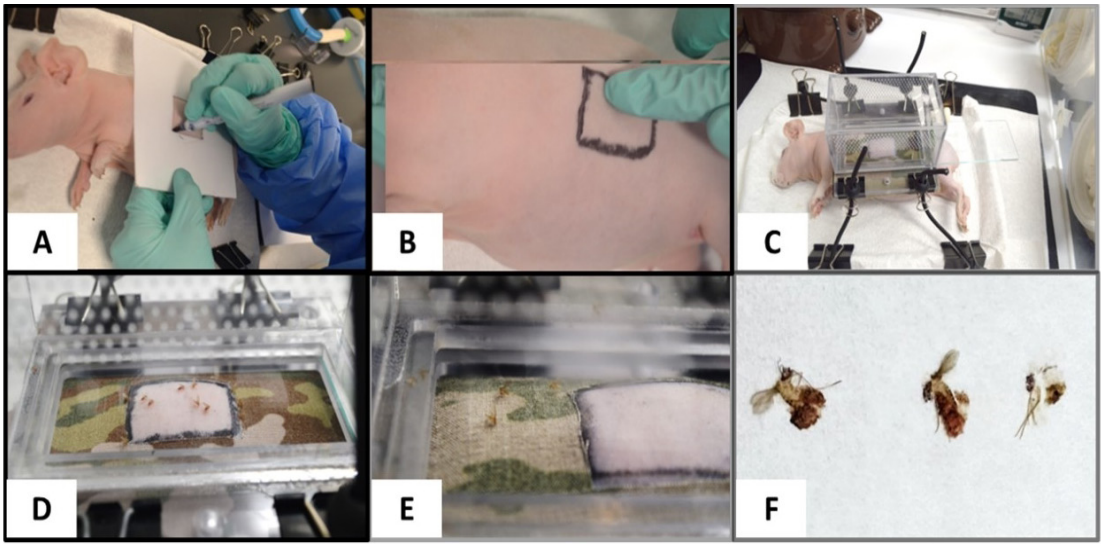
ANIMAL HANDLING AND REPELLENT APPLICATION

Briefly, guinea pigs were anesthetized via isoflurane using an induction chamber. Then, the animals were weighed and an outline for treatment area was drawn on the skin (Figure 1) using a Teflon® template. Twenty (20) microliters of the respective commercially available DEET, picaridin, or IR3535 repellent was applied topically to a 3 X 4 cm rectangle area marked for treatment on each animal. The application rate for IR3535 and picaridin was 1.67 mg/cm^2 and the application rate for DEET was 2.08 mg/cm^2. The guinea pigs were placed individually in a cage to recover for one hour.

Bite Prevention assay

One-hour post-topical repellent application, guinea pigs were sedated using ketamine 30-70mg/kg and xylazine 5mg/kg via intraperitoneal injection. Sedation was verified via toe pinch. Once sedated, a clear, sealed insect observation cage containing 20 female sand flies was secured onto the flank of the guinea pig (Figure 1) treated with one of the components of the repellents (DEET, picaridin, or IR3535). Each guinea pig was then moved into a large, transparent observation chamber (Figure 1) at 24-26oC and 51-80% humidity. Sand fly feeding was observed and recorded for 20 minutes. Next, the insect observation box was removed, and the sand flies were aspirated into a paper holding cup, and the guinea pigs were allowed to recover from sedation. A sugar pad containing a 30% sucrose solution was placed on top of the sand fly holding cup and transferred to a reach-in incubator at 26°C and 80% temperature and humidity, respectively. After one hour, the cup was removed from the incubator and gently tapped for first assessment and counting of flies that are knocked down. The number of sand flies appearing dead or knocked down was recorded. Knockdown was defined as a sand fly laying on its back or side and unable to maintain flight after a gentle tap against the holding cup. Then, the holding cup was placed back into the incubator until 24 hours post exposure. A second assessment was conducted at this timepoint following the

Figure 1: Development of an in vivo animal model to mimic host exposure to sand fly bites. Blood meal and knockdown status of Phlebotomus papatasi females were evaluated in a hairless guinea pig wearing untreated, permethrin-treated, and etofenprox-treated uniform in the presence or absence of topical repellents (DEET, Picaridin, and IR3535). A-B: Application area of topical Repellent. C: Full representation of guinea pig exposure to sand fly bites. D-E: Sand flies landing on exposed skin or uniform. F: Evaluation of blood meal status after 24-hour exposure.

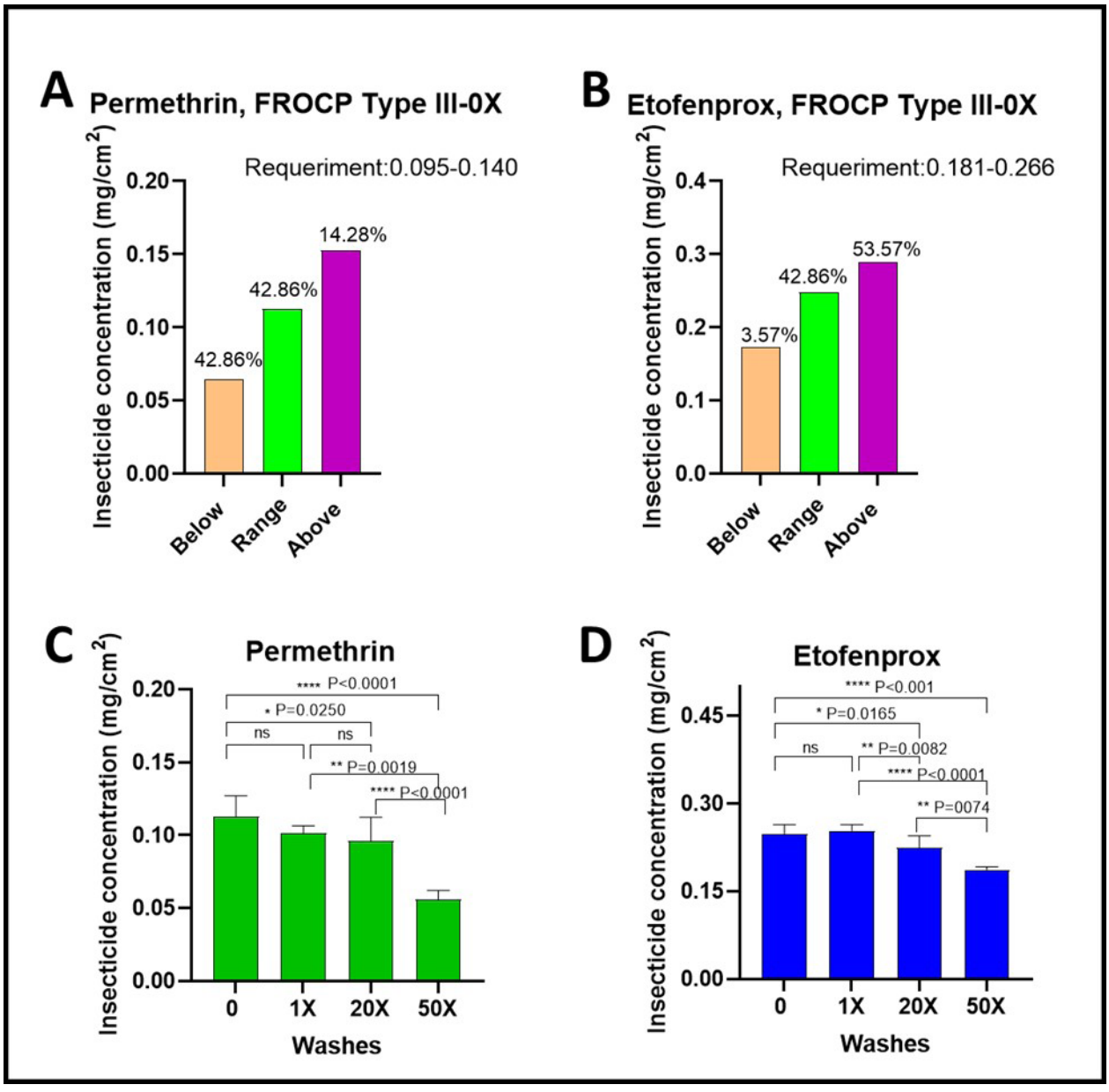


procedure described above. Mortality was not assessed because flies were frozen for assessment of blood meal intake. After the second assessment, the holding cup was placed in the freezer for 24 hours to ensure all sand flies were dead prior to the determining the presence of a blood meal. Sand flies were then removed and placed onto a white filter paper and crushed to determine the presence or absence of a blood meal in their abdomen. The number of blood-fed sand flies was recorded for each treatment.

STATISTICAL ANALYSIS

Each guinea pig was used up to five times in the experiments. A test number was assigned for each animal using GraphPad Prism 9 software randomization generator. A minimum rest period of seven days between assays was employed for each animal. Data was collected on the number of sand flies that fed on guinea pig's blood for each experiment. Descriptive analyses were performed, and the mean and standard deviations reported for each treatment. There were three exposures: treatment, concentration levels, and number of washes. Since the design is unbalanced for the control group, a general linear regression model was used for ANOVA analyses. Multiple comparisons were performed by the Tukey approach. Equal variance and distribution were

Figure 2.



examined. If the assumption of ANOVA was violated, data transformation was used first. Using four animals per group, power is 85% to 90%, having unequal test for two sample means, or ANOVA contrast.

RESULTS

The GC-MS analysis conducted on all treated materials, before washing treatment, revealed a high variability in the impregnation levels of permethrin. Only 17.2% of the samples achieved the recommended levels of the active ingredient (0.095-0.140 mg/cm^2, Figure 2A). About 82.8% of the materials were out of the recommended ratio with 58.6% and 24.2% representing the low and high levels. Inversely, the impregnation process with etofenprox revealed high levels of compliance with 97.3% of the materials achieving the recommended (44.7%) or the above ratio (52.6%) of the active ingredient (Figure 2B). This assessment was essential to down select and advance the materials in compliance to the sand fly bite challenge studies. This data revealed the relevance to validate the impregnation process of the active ingredient of each batch treated uniforms produced. Permethrin and etofenprox have specific affinities with different ratios of success during the impregnation process. Additionally, the active ingredient is washed from the uniforms in a dose-dependent manner, mainly in permethrin-treated uniforms (Figure 2C and D).

Because sand flies are small in size and fragile, unnecessary handling and exposure to changes in environmental conditions (temperature, humidity) were avoided post sand fly exposure. Mortality data was not recorded to avoid manipulation of flies and preserve flies for 24 hours to conduct blood meal intake assessment. We established a simple technique to evaluate blood meal intake on white paper to mitigate potential visual challenges from late blood meal assessment which would cause failure in the detection of blood in partially fed females or in those with potential fast digestion. The results showed no difference in the percentage of blood-fed sand flies with any insecticide type (permethrin or etofenprox) (Figure 3). However, there was a significant difference in the percentage of blood-fed females when untreated materials were compared to permethrin-treated and etofenprox-treated materials. A significance in blood-fed sand flies at 1X wash was observed only in the permethrin treated uniforms when compared to the untreated material (p=0.033). At 20X washes, both permethrin and etofenprox displayed significance in the number of blood-fed sand flies when compared to the untreated material (p=0.025 and p=0.007 respectively).

Figure 3: Percentage of blood meal of Phlebotomus Papatasi females (n=20, four replicates) exposed to an animal model to mimic the use of untreated, permethrin-treated, and etofenprox treated uniforms as well host skin areas uncovered by the uniforms. Blood meal was assessed at 1 hour and 24-hour post exposure to uniforms washed 1, 20 and 50 times. Blood meal was not detected in sand flies exposed to animals that received topical repellents on uncovered skin (data not shown).

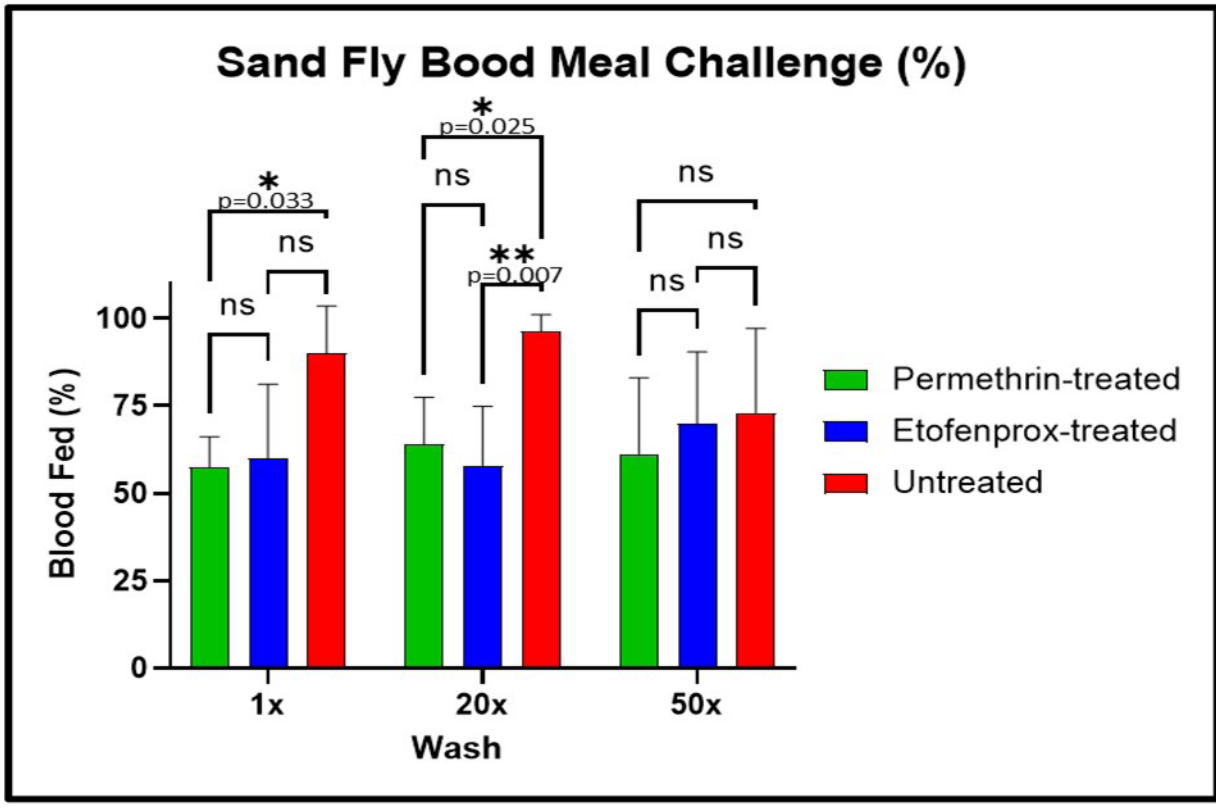
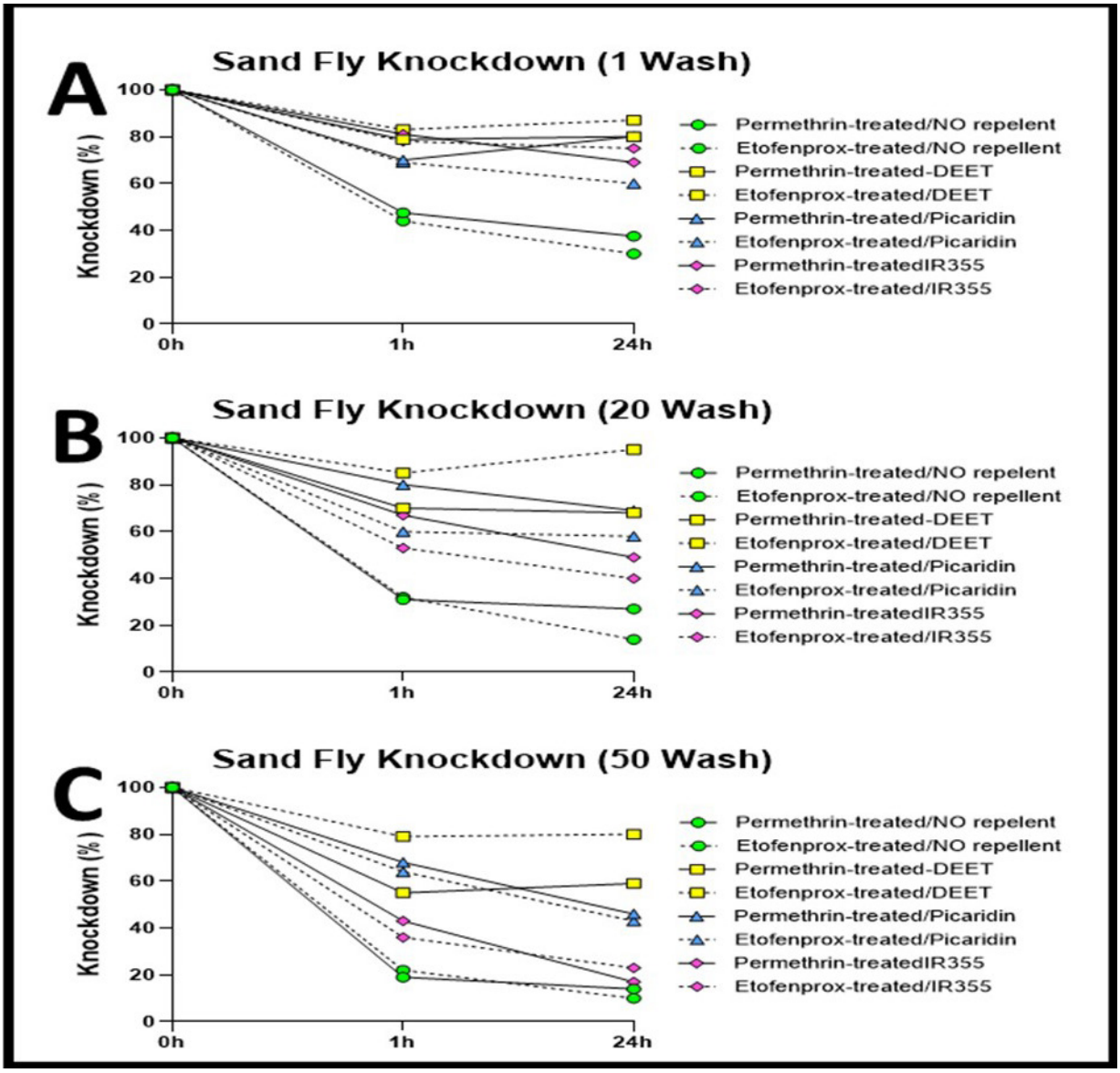


Figure 4: Knockdown of Phlebotomus papatasi females (n=20, four replicates) in the presence or absence of different repellents applied to the exposed skin of a hairless guinea pig host wearing a permethrin-treated or etofenprox-treated uniform. Knockdown was assessed at 1 hour and 24-hour post exposure in uniforms washed 1, 20, and 50 times. Mortality was not measured as females were used to assess blood meal status.



No significance was observed between all treatment types at 50X washes. No significant difference in the percentage of blood-fed sand flies were detected across the three wash time points (1, 20, and 50 washes), irrespective of uniform treatment, ($p=0.713$). Additionally, the effect of uniform material did not vary by the number of washes, and the number of washes did not vary in different uniform types. This data indicates that the treatment type rather than the number of washings is the source of variability (Figure 3). A pairwise comparison on the uniform types indicated that there was no significant difference between permethrin-treated and etofenprox-treated materials. However, there was a significant difference between permethrin-treated and etofenprox-treated materials when compared to the untreated materials ($p=0.0034$ and $p=0.051$ respectfully). Complete absence of feeding was observed when treated uniforms were combined with any of the tested repellents suggesting a potential synergetic effect of both repellents and uniforms (data not shown).

The knockdown data was evaluated, with no statistical significance observed in the uniform treated groups (permethrin and etofenprox). The data was compared in the absence or presence of topical repellents (Figure 4A). The percentage of sand fly knockdowns increased when both treated uniforms (permethrin and etofenprox) were evaluated in the presence of topical repellents. The percentage of knockdown was reduced in uniforms washed 20 and 50 times. Our data revealed that treated uniforms in conjunction with DEET treated on exposed skin led to a

recovery-type knockdown pattern (24 hours) of sand flies, as opposed to the other repellents tested (picaridin and IR3535) that led to a kill-type knockdown profile. Sand fly probing and mortality were not recorded in this study.

DISCUSSION

This study reflects the first laboratory evaluation of factory treated FRACU uniform, Type III material, to prevent bites from laboratory-reared sand fly *Phlebotomus papatasi*. Bite prevention through treated uniforms and topical repellents remain the best strategy to protect Warfighters against leishmaniasis when deployed to endemic areas with large populations of sand fly species. Unlike mosquitoes that have a long proboscis, sand flies have small mouthparts that are physically unable to penetrate the U.S. military uniforms and reach the Soldier's skin. Therefore, the use of uniforms represents a strong mechanical barrier and first line of protection against sand fly bites. Uniforms do not protect exposed skin (i. e. hands, neck, and face) thus, additional protection methods such as topical repellent are highly recommended as confirmed by our studies here. Our study design allowed us to explore and answer several questions regarding the effectiveness of treated U.S. military uniforms to protect against sand fly bites in the absence or presence of authorized topical repellents. Bite protection was minimal with ~ 10% observed in untreated uniform material. However, a synergistic effect (mechanical plus active impregnation product) may explain the 40% of bite prevention observed in both permethrin and etofenprox-treated materials without topical repellent. Interestingly, the levels of bite prevention were higher when topical repellents were applied to the exposed host skin in the presence of treated uniform (> 95%). Our knockdown evaluation revealed that more than 40% of the sand flies were knocked down after 1 hour post exposure to treated materials. An increase (70-80%) was observed when topical repellents were present. The feeding cages offered limited space which may have caused the sand flies to unintentionally contact the treated uniforms at times in their attempt to fly away from the treated skin area (Figure 4A).

The results of this study demonstrate the need to use the complete insect repellent system. The best protection occurred when both treated uniform material and an authorized military repellent were used. Although the simultaneous use of treated uniforms and repellent proves to be effective at bite prevention and subsequent transmission of disease, vector-borne disease is still a force health protection concern due to noncompliance. Therefore, user acceptability plays an important role in any personal protection measure. Previous studies on sand fly response to pyrethroid treated uniforms have been performed using human volunteers in a field environment. Here we demonstrated that a hairless guinea pig model can be used with similar results. Since human use protocol approval and volunteer recruitment is highly restricted, time-consuming, and expensive, the hairless guinea pig model can supplement or possibly replace the use of human volunteers.

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Disclaimer

Material has been reviewed by the Walter Reed Army Institute of Research. There is no objection to its presentation and/or publication. The opinions or assertions contained herein are the private views of the author, and are not to be construed as official, or as reflecting true views of the Department of the Army or the Department of Defense. Research was conducted under an IACUC-approved animal use protocol in an AAALAC International - accredited facility with a Public Health Services Animal Welfare Assurance and in compliance with the Animal Welfare Act and other federal statutes and regulations relating to laboratory animals.

References

1. Coleman RE, Burkett DA, Putnam JL, Sherwood V, Caci JB, Jennings BT, Hochberg LP, Spradling SL, Rowton ED, Blount K, Ploch J, Hopkins G, Raymond JW, O'Guinn. 2006. Impact of phlebotomine sand flies on U.S. military operations at Tallil Air Base, Iraq: 1. Background, military situation, and development of a "Leishmaniasis Control Program". *Journal of Medical Entomology* 43:647-662.
2. Soto J, Medina F, Dember N, and Berman J. 1995. Efficacy of permethrin-impregnated uniforms in the prevention of malaria and leishmaniasis in Colombian soldiers. *Clinical Infectious Diseases* 21:599-602.
3. Cilek, J.E., Peterson J.L., and Hallmon, C. 2004. Comparative efficacy of IR3535 and DEET as repellents against Aedes aegypti ad Culex quinquefasciatus. *J. Am. Mosq. Contr. Assoc.* 20: 299-304.
4. Army Public Health Center.DoD Insect Repellent System. FACT SHEET 18-009-1218. 2021. Available online.
5. AFPMB Technical Guide No. 36. http://www.afpmb.org.
6. EPA. Etofenprox registration #82392-3. 2016. Available online: https://www3.epa.gov/pesticides/chem_search/ppls/082392-00003-20160822.pdf.

7. Klun, J.A., Ashot, K., and Debboun, M., J.2006. Repellent and Deterrent Effects of SS220, Picaridin, and Deet SuppressHuman Blood Feeding by *Aedes aegypti*, *Anopheles stephensi,* and*Phlebotomus papatasi.*Med. Entomol. 43(1): 34-39.

8. Weeks, E.N.I., Wasserberg, G., Logan, J.L., Agneessens, J., Stewart, S.A., and Dewhirst, S. 2019. Efficacy of the insect repellent IR3535 on the sand fly Phlebotomus papatasi in human volunteers. *J. Vec. Ecology.* 44 (2): 290-292.

9. Asilian, A., Sadeghinia, A., Shariati, F., Jome, M.I., and Ghoddusi, A. 2003. Efficacy of permethrin-impregnated uniforms I the prevention of cutaneous leishmaniasis in Iranian soldiers. *J. Clin. Pharmacy and Theraputics* 28: 175-178.

10. Ready PD. Biology of phlebotomine sand flies as vectors of disease agents. *Annu Rev Entomol*. 2013;58:227-50. doi: 10.1146/annurev-ento-120811-153557. PMID: 23317043.

11. Buchta JN, Zarndt BS, Garver LS, Rowland T, Shi M, Davidson SA, Rowton ED. Blood-Feeding Behaviors of Anopheles stephensi but not Phlebotomus papatasi are Influenced by Actively Warming Guinea Pigs (Cavia porcellus) Under General Anesthesia. *J Am Mosq Control Assoc.* 2015 Jun;31(2):149-54. doi: 10.2987/14-6467. PMID: 26181690.

12. Lawyer P, Killick-Kendrick M, Rowland T, Rowton E, Volf P. Laboratory colonization and mass rearing of phlebotomine sand flies (Diptera, Psychodidae). *Parasite.* 2017;24:42. doi: 10.1051/parasite/2017041. Epub 2017 Nov 15. PMID: 29139377; PMCID: PMC5687099.

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Observations of Tactical Army Medicine in Crisis Europe:

A Two-year Analysis of Medical Battalion (Multifunctional) (MMB) Support Operations from 1 April 2022 to 31 March 2024

MAJ David S. Coons, LTC Thomas C. Collette, MAJ Louis 'Brad' Smith

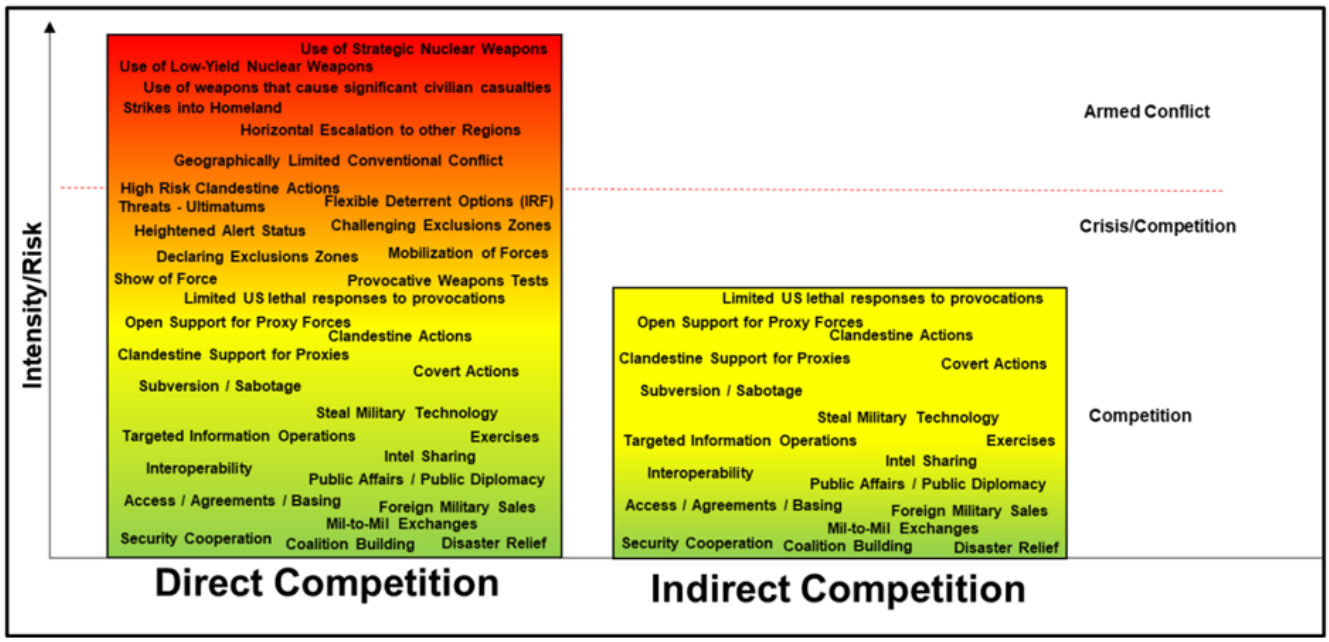
INTRODUCTION:

The medical operations perspective and data shared here occur in the backdrop of the geographically limited conventional conflicts between Russia and Ukraine, and Israel and Hamas. American Soldiers stand guard with North Atlantic Treaty Organization (NATO) allies along Europe's eastern flank against further Russian aggression as part of Operation Atlantic Resolve. Operation Atlantic Resolve was initiated in 2014 following Russia's limited invasion into the Donbass region of Ukraine but increased in magnitude with the full Russian invasion of Ukraine in 2022; the data set analyzed here begins two months after the invasion and covers the subsequent two-years. American Soldiers receive Echelon Above Brigade (EAB) medical support from U.S. Army medical units garrisoned in Germany, or forward stationed Regionally Aligned Forces (RAF), attached to Germany-based medical headquarters. The Joint Concept for Integrated Campaigning introduces the concept of the 'Conflict Continuum' as an intellectual framework to achieve and sustain desired conflict outcomes, describing circumstances in Europe as "competition below armed conflict."[1] Further detail is provided by the Chief of Staff of the Army's paper, the Army in Competition, which places events in Europe at the highest intensity and risk within the direct crisis/competition category; just below the threshold of open armed conflict.[2] These events provide the lens and opportunity to observe medical EAB support operation requirements in a potential pre-Large Scale Combat Operations (LSCO) environment and draw medical inferences for LSCO itself.

This article represents the final chapter in a three-stage project: (1) improve internal unit understanding of medical support operations, (2) improve medical support to customer units by sharing knowledge and lessons learned, and (3) share a picture of the current European medical operating environment with the greater Army Medical Department (AMEDD) professional community. The unit described is the 421st Medical Battalion (Multifunctional) (MMB), 30th Medical Brigade, forward stationed at Smith Barracks, Baumholder, Germany. For perspective, U.S. Army Garrison Baumholder is approximately 720 miles from the Ukrainian border, or roughly the distance of Washington, D.C. to St. Louis, Missouri. The 421st MMB provides scalable, flexible, and modular medical mission command, health service support, and force health protection through assigned and attached medical units in support of United States Army Europe & Africa (USAREUR-AF). The 421st MMB, battalion-level Area of Operations (AO) constitutes more than 27% of the Earth's land surface, with routine operations occurring between the Artic Circle and southern East Africa. There are five Active Duty MMBs within the United States Army, and while each possesses roughly the same capabilities, each has a unique subordinate unit composition. 421st MMB currently consists of six organic units plus two RAF units. Units assigned to 421st MMB include: 421st MMB Headquarters & Headquarters Detachment (HHD), 8th Medical Logistics Company (MLC), 64th Medical Detachment (Veterinary Services) (MDVS), 71st Medical Detachment (Preventive Medicine) (PM), 254th Medical Detachment Combat and Operational Stress Control (COSC), and 557th Medical Company (Area Support) (MCAS). The two attached RAF units include a Forward Dental Treatment Section (FDTS) from an Active-Duty Dental Company (Area Support) (DCAS) plus a National Guard MCAS. In total, the 421st MMB consists of approximately 400 Soldiers.

The first stage of the project consisted of improving internal understanding of unit operations. Typical means of generating understanding for garrisoned-based Army units include the Command & Staff, and training meetings. However, for forward deployed units supporting the high OPTEMPO found in Europe, it becomes exceedingly difficult to judge degrees of success through percentage based

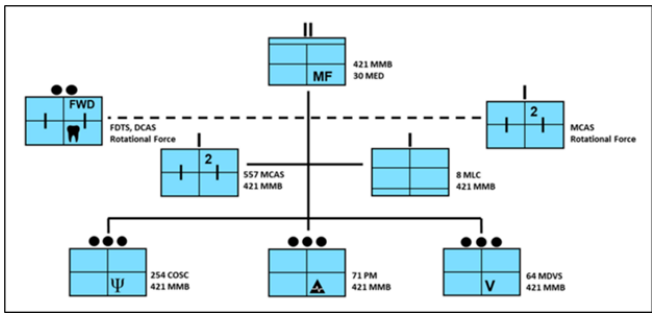
Figure 1 – From the Army in Competition: "Illustrative Examples of Direct and Indirect Competition."[2]



"stoplight" charts alone. Within the sustainment community, the European experience has become a delicate balancing act of supporting typical CONUS garrison requirements and maintaining unit readiness, while simultaneously building interoperability and expanding relationships with European allies and supporting theater operational requirements common to the deployed environment.

To address the understanding gap, a Commander's Update Brief (CUB) was implemented and later refined to include analysis of medical support operations managed by the Battalion Support Operations (SPO) staff section in support of European Command (EUCOM), Africa Command (AFRICOM), and Central Command (CENTCOM) customer units. Elements of the Medical Battalion CUB include: (1) a 14-day mapped forecast of upcoming missions, (2) an abbreviated 90-day forecast of upcoming missions, (3) mapped history of emerging theater health threats, (4) status check of on-order contingency missions, (5) MMB CLVIII (medical supplies) inventory status, (6) supported CLVIII orders progression status, (7) deploying and redeploying team Soldier Readiness Program (SRP) timelines, (8) subordinate unit input (AARs, upcoming CONOPS, Disease Non-Battle Injury (DNBI) treatment statistics, and unit capability forecast). In presentation, the CUB mirrored the task organization of the 421st MMB SPO staff, organized into three sections: Medical Operations, Medical Logistics, and Force Health Protection operations. (Figure 3) HHD, Medical Battalion (Multifunctional) Task Organization, represents the current Modified Table of Equipment (MTOE) organization as of May 2024, where both the Preventive Medicine Section and Mental Health Section operate within the Force Health Protection operations section. Within the context of improving internal understanding of unit operations through the CUB, MMB medical support mission data was analyzed, accounting for 24 months of medical support operations provided to EUCOM, AFRICOM, and CENTCOM.

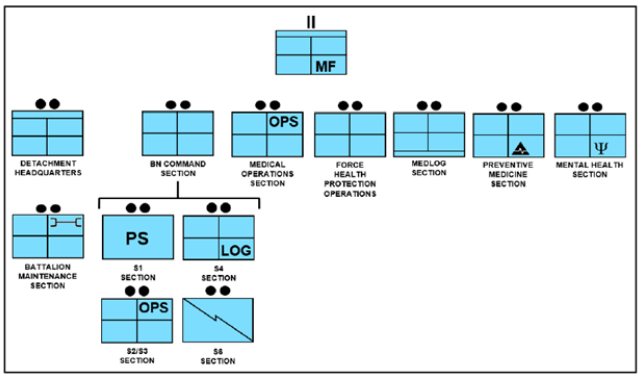
Figure 2 – 421st Medical Battalion (Multifunctional) Task Organization (current as of May 2024).



METHOD:

The CUB analysis, and data set in review, considered 377 missions recorded by the SPO staff, of which 274 were identified as valid medical support missions. The 274 medical support missions were conducted over a 24-month period, or 730 days, from 1 April 2022 to 31 March 2024. For each mission recorded, the following data points were collected: (1) executing subordinate unit, (2) SPO assigned mission tracking number, (3) specific mission site, (4) country, (5) Geographic Combatant Command (GCC), (6) mission title,

Figure 3 – HHD, Medical Battalion (Multifunctional) Task Organization.[3]



(7) medical mission type, (8) doctrinal medical function, (9) supported customer or higher headquarters, (10) number of MMB personnel executing the mission, (11) dates of execution (both calendar and Julian), and (12) mission duration in days.

For inclusion criteria, a valid medical support mission was defined as a mission which directly supported a doctrinal medical function performed by 421st MMB. FM 4-02, Army Health Systems, describes the Army Health System (AHS) as a system of systems composed of ten medical functions (see Figure 4)[4] The 421st MMB is a tremendously capable medical organization, supporting nine of the ten medical functions; the only exclusion being hospitalization. An MMB is the only Army medical unit type which possesses such a robust capability. Further, for inclusion, the mission had to support an external customer unit, meaning a customer outside of organic 421st MMB.

Of the 377 recorded missions by the SPO Section, 103 were excluded. This analysis excluded taskings of a non-medical nature managed by the S3 Section, despite the mission contribution to AO Victory and USAREUR-AF support, such as escort of Arms, Ammunition, and Explosives (AA&E). The focus of this study was understanding the requirements placed on organic 421st MMB subordinate units, therefore, for purposes of mission line analysis, RAF unit mission data was excluded as RAF units are deployed with the sole purpose of providing direct medical support to AO Victory units (i.e. those units assigned to Fifth Corps, known as Victory Corps). Further, it also excluded unit level training events which directly contribute to unit Mission Essential Task List (METL) requirements, as this reflects a mission requirement common to all Army medical units.

Of the 274 medical mission lines analyzed, each represents true medical mission support provided to USAREUR-AF. Of the nine medical functions which organic 421st MMB units can perform, seven medical functions were executed for purposes of this analysis. One shortcoming of this study is that each of the 274 mission lines received only one medical function label, though two or more functions may have been executed in rare instances. Only the primary medical function was selected to serve as the mission line identification. Of the organic 421st MMB units, only 557th MCAS possesses the ability to perform Dental Services. The Dental Services medical function was executed on a significantly limited basis and always executed in conjunction with the primary MCAS Medical Treatment function, which received the mission line label. Likewise, the Medical Laboratory Services function was performed by 557th MCAS, 64th MDVS, and 71st PM on a limited basis, however, it was always secondary to the primary medical function of Medical Treatment, Veterinary Services, or Operational Public Health respectively (see Figure 4, Medical Functions Performed by 421st MMB).

Except for Unit Mission Load, described below, all results were calculated as simple percentages or summation counts of raw data. For example, a 7-day Contact Repair Team (CRT) mission executed by 8th MLC, carried the same weight as a 5-month Veterinary Service Support Team (VSST) mission executed by 64th MDVS; each mission is counted as one. This represents an obvious imbalance for data comparison given mission duration and personnel necessary to execute. To overcome this imbalance, the introduced calculation of Unit Mission Load was meant to find a truer representation of theater request-for-service demands placed upon subordinate units by accounting for the number of days the mission was executed, and the number of Soldiers required for mission execution. In practice, Unit Mission Load is expressed as a percentage with comparison to other 421st MMB subordinate units (see Figure 5 – Unit Mission Load Formula).

RESULTS:

The analysis revealed that a new medical support mission was executed by 421st MMB organic units every 2.664 calendar days or 1.903 business days over the two-year period in support of USAREUR-AF. This rate increases when considering the most recent one-year period, where a new medical support mission has been executed every 1.498 business days. When including attached RAF units, within any two-week operating window, the MMB averaged 127 personnel, or 32% of the MMB's total strength, forward deployed at 14 sites in 8 different countries. During the same two-week operating window, 7.1 of 8 subordinate units had personnel forward deployed, meaning nearly every subordinate unit had personnel deployed on a medical support mission with each two-week period of the last two years.

The most deployed organic unit was the 64th MDVS, accounting for 41% of the Battalion's deployed mission load. 64th MDVS executes an enduring food inspection mission in support of AO Victory, an enduring VSST(-) mission in

Figure 4 – A 'System of Systems' – the ten AHS medical functions.[4]

Figure 4 – Medical Functions Performed by 421st MMB.

Functions Analysis within this Study	The 10 AHS Medical Functions	HHD	8th MLC	64th MDVS	71st PM	254th COSC	557th MCAS	RAF FDTS, DCAS	RAF MCAS
X	Medical Command and Control	X	X	X	X	X	X		X
X	Medical Treatment						X		X
	Hospitalization								
X	Medical Evacuation						X		X
X	Medical Logistics		X						
X	Operational Public Health				X				
X	Combat and Operational Stress Control					X	X		X
X	Veterinary Services			X					
	Dental Services						X	X	X
	Medical Laboratory Services			X	X		X		X

Key:	Medical Command & Control	Health Service Support	Force Health Protection	RAF Unit Excluded	Function Not Performed

Figure 5 – Unit Mission Load Formula.

Unit Mission Load = Mission Duration (# days) * Mission Personnel Requirement (# Soldiers)

support of Kosovo Forces (KFOR), and a deployed VSST in support of Combined Joint Task Force – Horn of Africa (CJTF-HOA). Further, 64th MDVS executes the most common mission type, the Food and Water Risk Assessment (FWRA), with 40 missions executed over the last 24 months (the true number of FWRAs executed is higher, as FWRAs were executed in batches, but only tracked as a single FWRA TDY mission). FWRAs ensure safe food sources and preparation practices are available and used, predominately within host-nation facilities common to USAREUR-AF exercises, Sea Port of Debarkation (SPOD) operations, and AO Victory.

DISCUSSION:

THE IMPORTANCE OF FORCE

HEALTH PROTECTION:

The Medical Treatment and Medical Evacuation functions are arguably the mainstay of tactical Army medicine. Most 70-series Medical Service Corps professional literature is centered upon these two critical medical functions of the Health Service Support (HSS) element of the sustainment warfighting function. However, this analysis reveals that for the sub-kinetic theater currently found in crisis Europe, Force Health Protection (FHP) functions deserve considerably more professional attention, representing 64% of the MMB medical mission requests (See Figure 7 – Missions by Warfighting Function Elements as a Percentage).

The significant imbalance of FHP missions (64%) over HSS missions (28%) creates operational planning challenges. HSS within the Sustainment Warfighting Function is generally well understood in basic terms by the sustainment

Figure 6 Missions by Doctrinal Medical Function Experssed as a Percentage

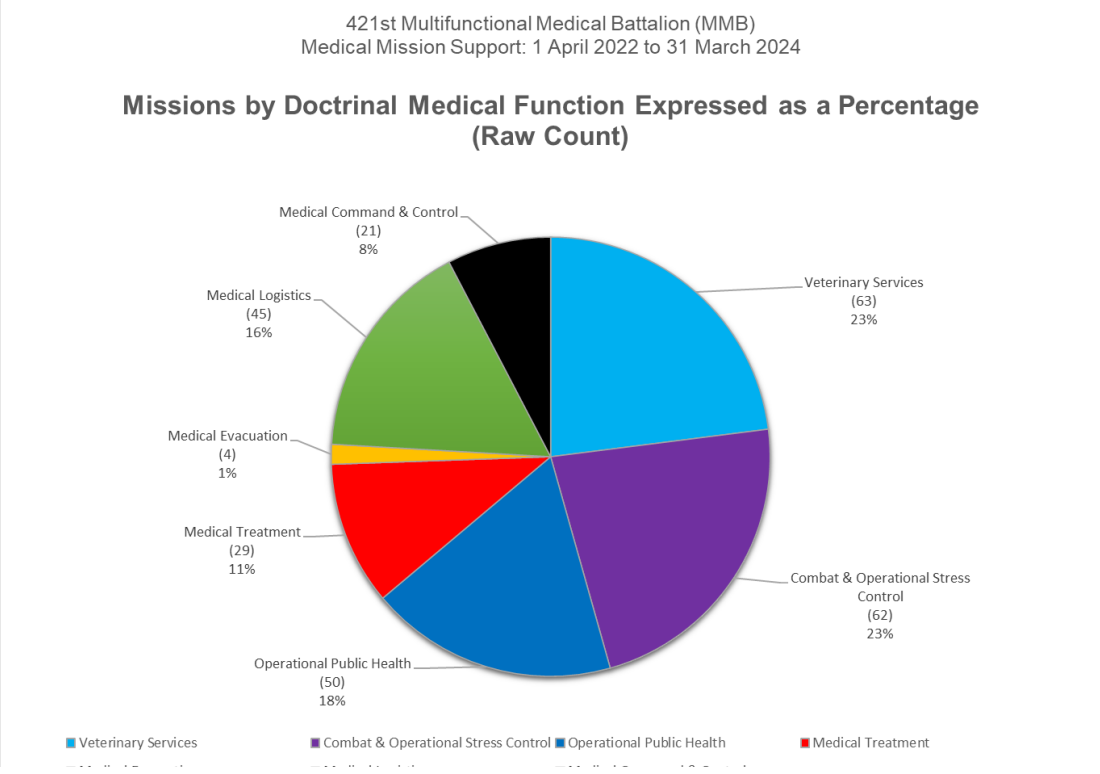


Figure 7 – Missions by Warfighting Function Elements Expressed as a Percentage.

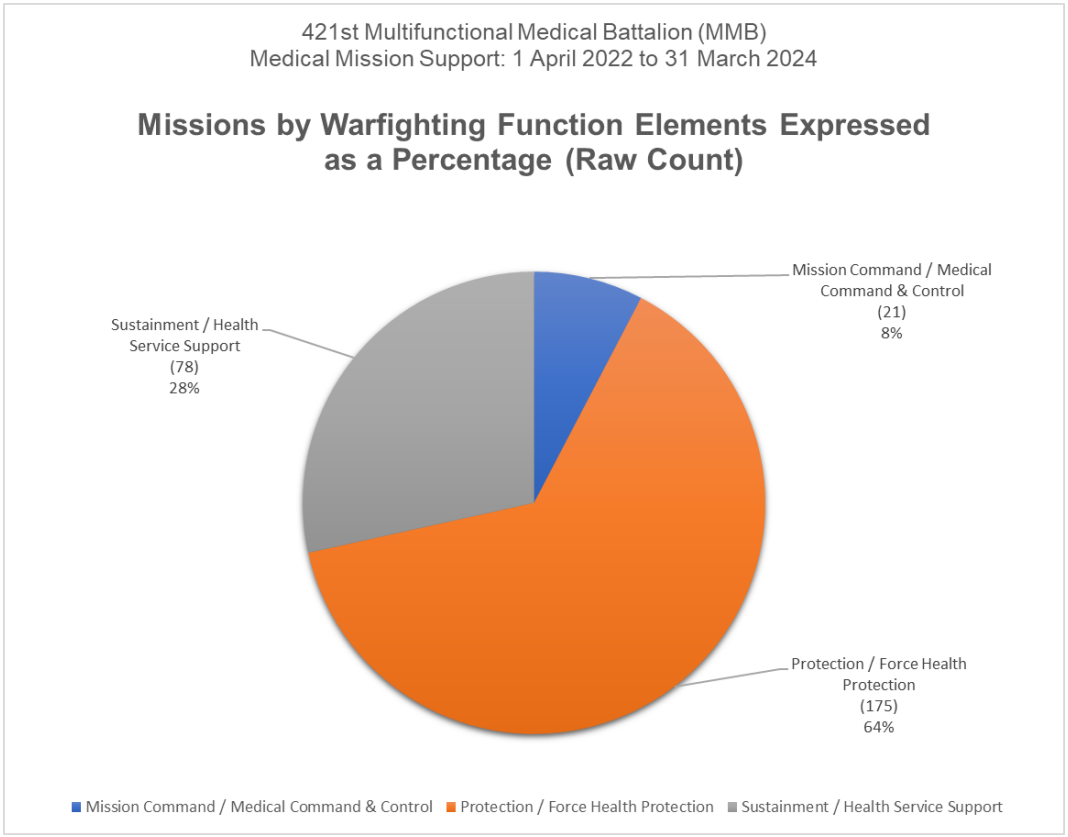


Figure 8: Missions by Geographic Combatant Command Supported Expressed as a Percentage

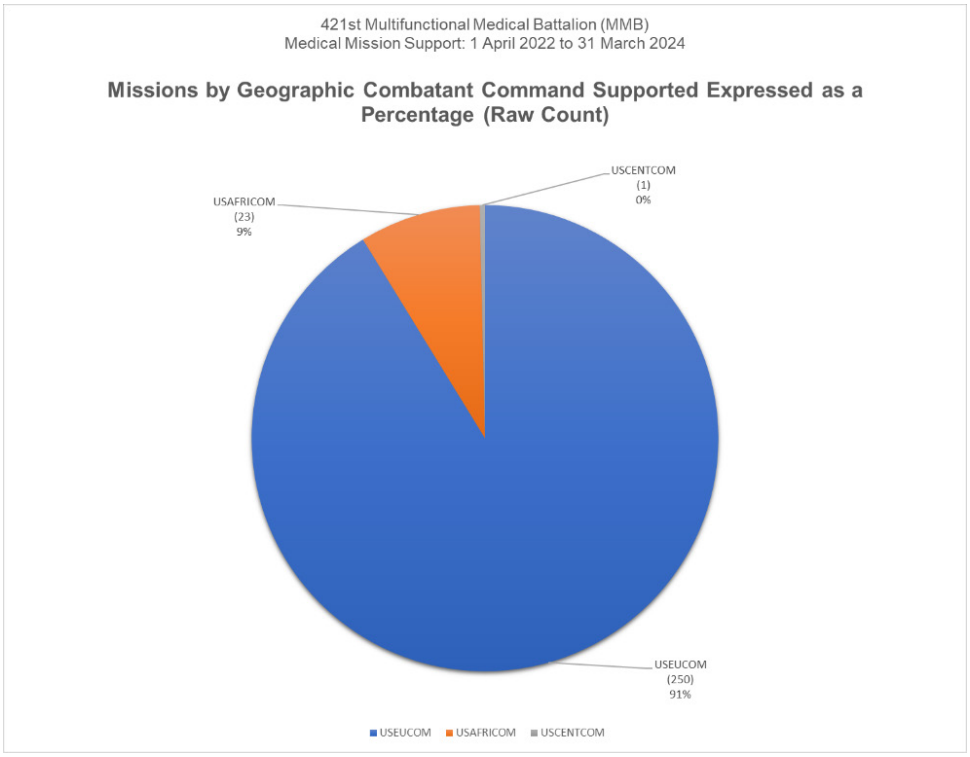


Figure 9: Missions by Customer Type Expressed as a Percentage. An AO Victory Unit represents a RAF unit customer on rotation and attached or serving V Corps. A USAREUR-AF Unit represents a customer unit permanently assigned to Europe. A USAREUR-AF Exercise includes any USAREUR-AF exercise or Global Health Engagement (GHE) support. An USARCENT Unit represents an Army customer unit assigned to USCENTCOM.

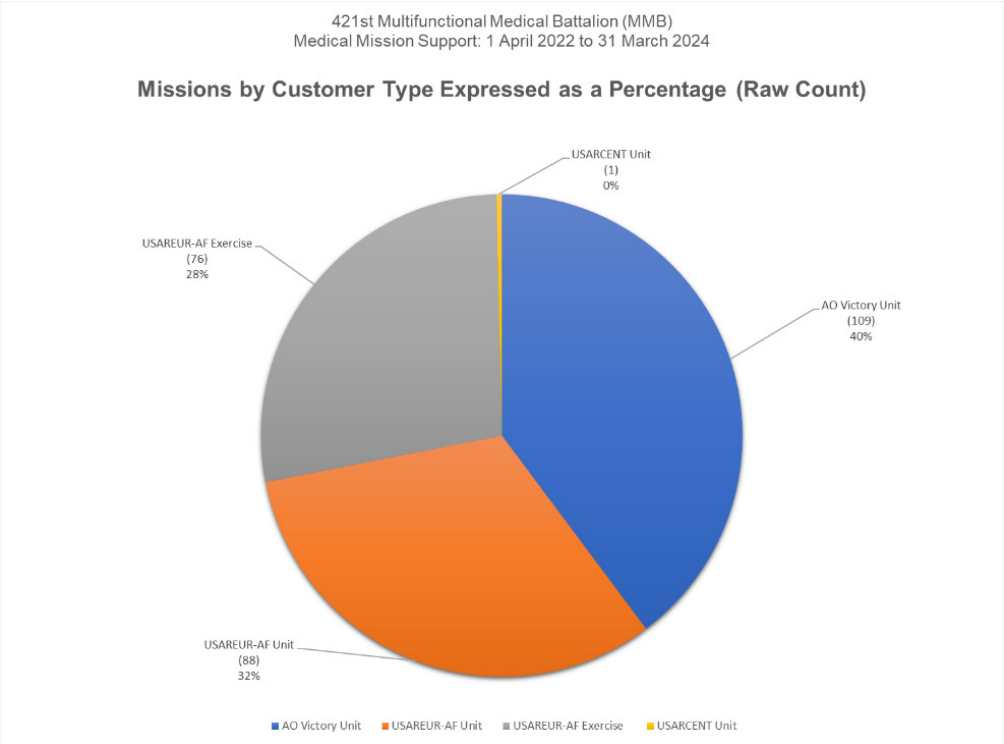


Figure 10: Unit Mission Load Expressed as a Percentage. [Unit Mission Load = Mission Duration (# Days) * Mission Personnel Requirement (# Soldiers)]

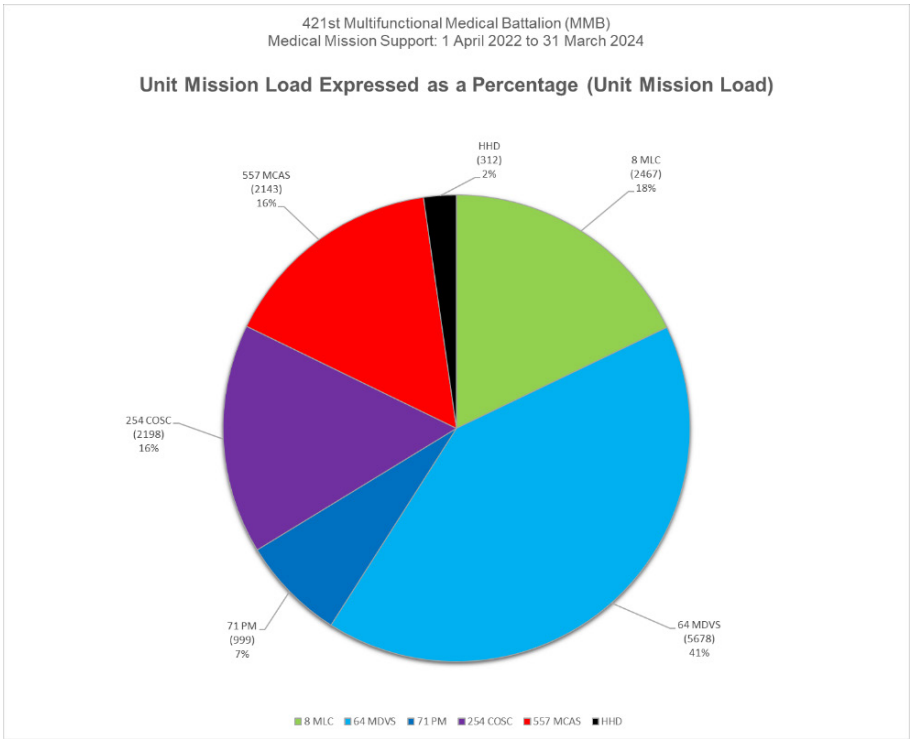


Figure 11: Medical Mission Support Quantified by Type

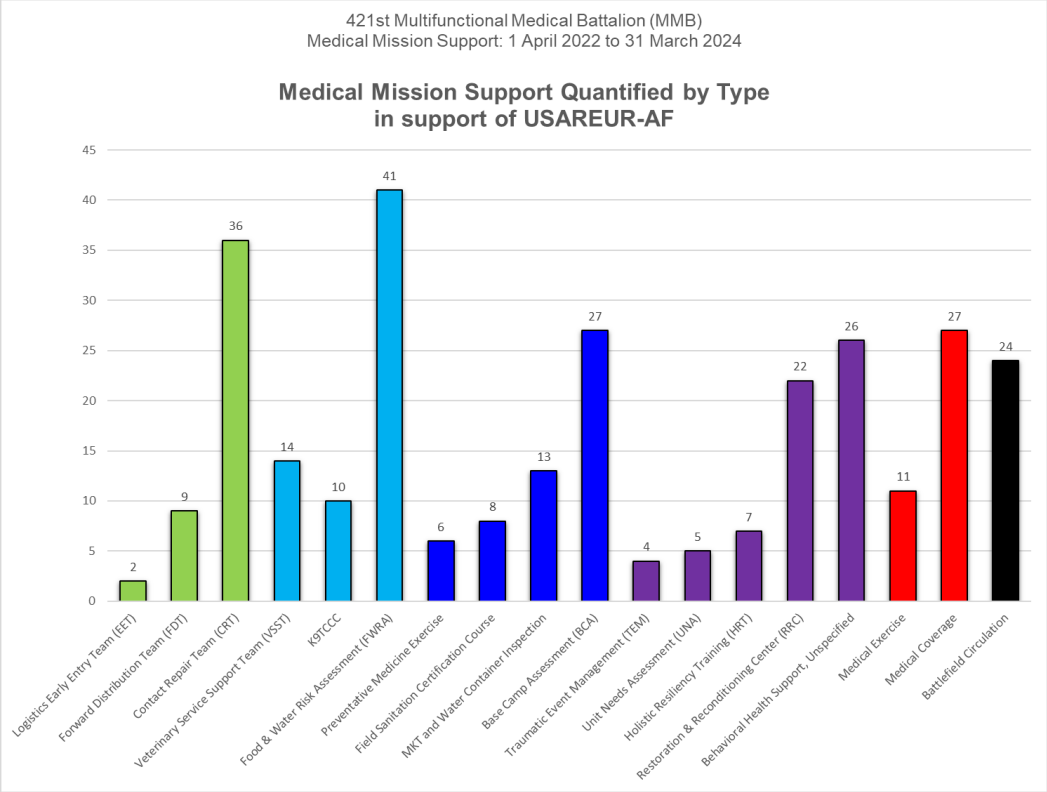
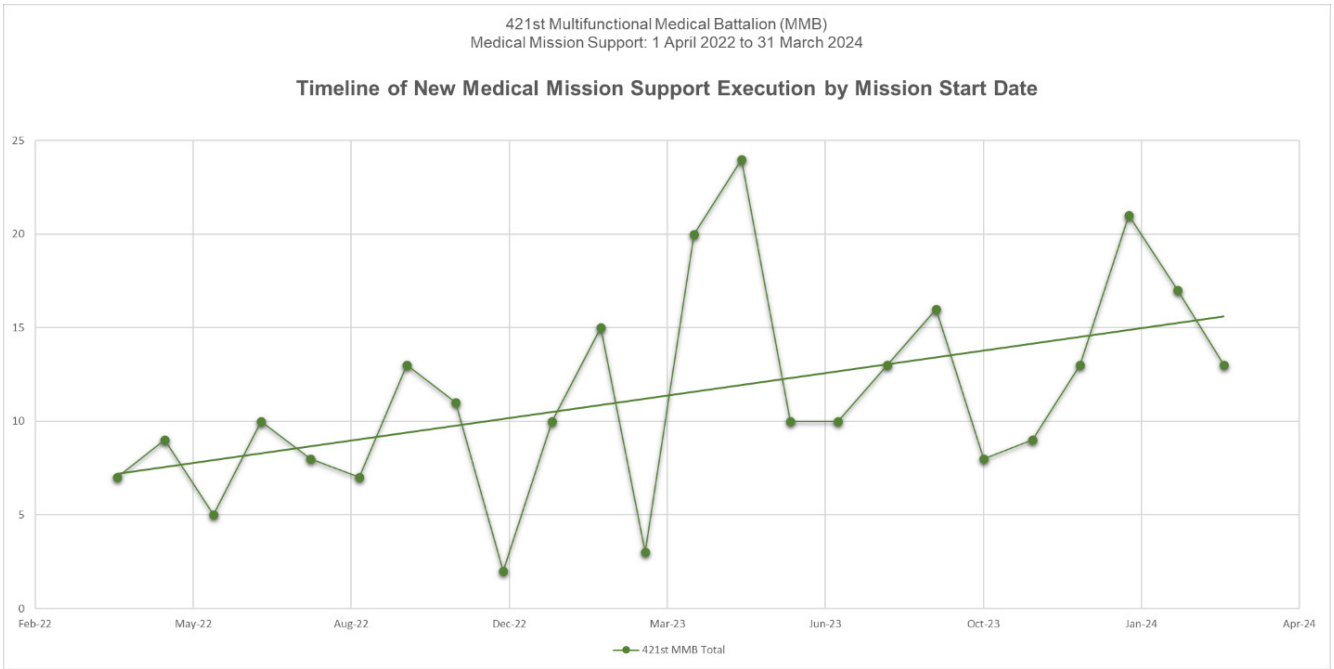


Figure 12: Timeline of New Medical Mission Support Execution by Mission Start Date (with trendline).



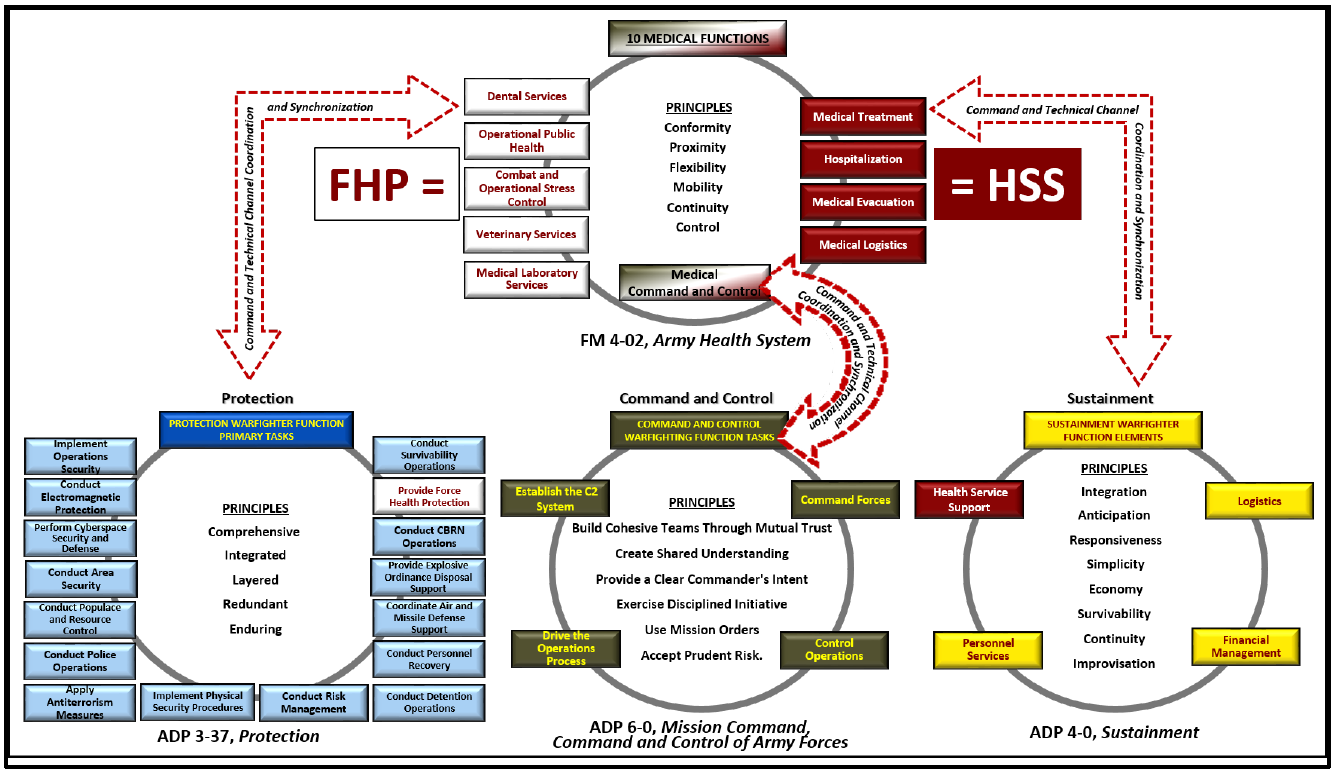


Figure 13 – Ten Medical Functions Aligned with Warfighting Functions.[5]

community, whereas FHP understanding significantly lags. The sustainment community's lack of familiarity with specialized FHP missions, specifically among MDVS, COSC, and PM mission types, often results in delayed or frustrated missions where key mission details required for mission execution are either vague or absent from tasking orders written by medical and non-medical personnel alike. For example, exercise support medical requirements must be incorporated into the exercise support planning otherwise the exercise or training audience commander could unknowingly or unnecessarily accept preventable health risks. A portion of this risk is rooted in the task organization of sustainment and medical headquarters in Europe where a Theatre Sustainment Command (TSC) staff surgeon office is not manned to direct the efforts of a Medical Brigade, though the staff surgeon office is the subject matter expert for the TSC. Likewise, a sustainment G3 operations sections does not possess the essential medical mission knowledge to direct a Medical Brigade. This prevalence of FHP missions speaks to the need for a Theater Medical Command with an inherent understanding of the FHP mission set, and correspondingly a strong, if not direct, command relationship with Medical Brigade and MMB operations.

As a direct result of the collective shortcomings to medical mission understanding and corresponding tasking frustrations among higher headquarters and customer units, 421st MMB published an FHP Customer Guide. The FHP Customer Guide represents the second stage of this overall project and was published with the intent of improving medical support to customer units through shared knowledge with non-medical higher headquarters and non-medical customers alike. A link to the FHP Customer Guide can be found within the references listed below.[6] Among the many important aspects of the FHP Customer Guide are the practical examples of mission timelines, where FHP medical support mission and requesting unit execution must be appropriately sequenced in time to afford the supported commander flexibility.

The curriculum at AMEDD Basic Officer Leader Course (BOLC) and Captain's Career Course (CCC) should also consider revision to align with this field observation of the increased importance of understanding FHP missions sets. While select AMEDD officers can attend Combined Logistics Captain's Career Course (CLC3) along with other sustainment community officers, there is no equivalent for the Protection Warfighting function where the FHP element falls (See Figure 13 – Ten Medical Functions Aligned with Warfighting Functions). This underscores the importance of a refined AMEDD CCC and BOLC curriculum to emphasize FHP mission planning. Examples include: (1) recognition of the differences between Base Camp Assessments (BCAs) and Occupational and Environmental Health Site Assessments (OEHSAs) as each mission set has different equipment requirements, is executed under different mission conditions, and produces assessments which are valid for different durations; and (2) delineation of COSC mission types,

such as Unit Needs Assessments (UNAs), Holistic Resiliency Training (HRT), and Traumatic Event Management (TEM) missions. While some of these missions are non-doctrinal, they are in common use in Europe and necessitate basic familiarity. The ability to educate non-medical command teams, then request, plan, and execute FHP missions with optimal timing to support the commander's intent has become an essential skill for Medical Service Corps officers forward deployed to Europe. For the majority of MMB missions, medical success in sub-kinetic Europe starts with a foundational understanding of FHP medical mission types.

MEDICAL PRIORITIES

Perspective is important when considering this data set. This data set represents a glimpse of the tactical mission demands required to support both Europe and Africa medically. The OPTEMPO found within USAREUR-AF since the 2022 Russian invasion of Ukraine has been climbing. Figure 12 – Timeline of New Medical Support Mission Execution by Mission Start Date includes a trendline for the 421st MMB. This trendline is based on the graphed total of subordinate organic unit missions. This increasing trendline is possibly due to improved systems and processes within the Battalion staff for tracking medical mission execution. However, more likely, it is a direct reflection of the growing medical support requirements found within theater over the last two years. 421st MMB has executed a medical support mission every 1.903 business days over the last two-year period. But when looking over the last year alone, 421st MMB has executed a medical support mission every 1.498 business days; the trend is clear.

This data set intentionally does not account for, nor include the standard Army unit requirements found within a non-forward deployed FORSCOM-based unit such as METL requirements training, fleet maintenance, Professional Military Education (PME), or Expert Field Medical Badge (EFMB) support, though these requirements remain critically important to unit-level operations. This data set also ignores the human realities of command, such as UCMJ, leave and passes, paternity leave, AIM cycles, Professional Military Education (PME), and compassionate reassignments, among others. This delicate balance of fulfilling both readiness and forward-deployed environmental requirements creates a situation where deliberate, thoughtful, and concise command priorities are crucial.

In terms of priorities, Figure 9, Missions by Customer Type as a Percentage, best represents where USARUER-AF leadership has prioritized employment of the EAB medical units of 421st MMB. While dedicated support to AO Victory accounts for 40% of the medical mission workload, this detracts from the 421st MMB's ability to support USAREUR-AF exercises which includes Global Health Engagement (GHE) missions. GHE missions build medical partnership and capability understanding with allied nations and sister services, at 28% mission workload. A recent example of this prioritization struggle is exemplified between allocation of 8th MLC medical logistics personnel to (1) assist in setting the theater by providing support to Army Preposition Stock (APS) inventories at the Dulmen Worksite facility, (2) developing sister service interoperability with the United States Marine Corps (USMC) and the United States Navy in Europe through Nordic Response 2024 in Bardufoss, Norway, and (3) providing Contact Repair Team support to RAF units in AO Victory, all executed simultaneously. The challenge of medical leadership in Europe is identifying the appropriate mission balance while acknowledging unit bandwidth is finite.

ADVICE FOR AO VICTORY

While 40% of MMB missions support AO Victory units, EAB medical support is not abundant along Russia's western border. This support requirement could be substantially decreased if deploying RAF units were held to theater entry requirements, similar to the Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) era. AO Victory medical requirements should remain in place until United States Army Garrison – Poland and corresponding Defense Health Agency (DHA) facilities reach a fully mission capable status; this is years away.

Suggested entry requirements include (1) Soldier Readiness Program MEDPROS validation for the duration of the deployment. Medical support often relies upon TRICARE I-SOS and host nation medical facilities for services beyond primary care, creating its own challenges. The expectation that units will arrive to AO Victory with 90-days of MEDPROS readiness and expect to increase their medical readiness while deployed is unrealistic for actions requiring support beyond unit internal assets. EAB medical units are not deployed for the sole purpose of maintaining MEDPROS: blood work, hearing, and dental services are appropriately limited. Rotating units should arrive, prepared medically for a standard 270-day deployment. (2) Medical equipment should be serviced in advance of arrival to Europe. If possible, medical maintenance plans should be adjusted to service equipment prior to deployment thereby ensuring equipment availability for patient care for the duration of the deployment. The expectation that 8th MLC will fix all medical maintenance issues immediately upon RAF unit arrival to Europe is misguided. 8th MLC is not funded to order CLVIII repair parts for all RAF units, plus turnaround time for repair parts can often exceed the timeline of the deployment. To prevent RAF units from redeploying from the theater without their medical equipment, 8th MLC returns Non-Mission Capable (NMC) equipment back to RAF units, coded and tagged per doctrine, and provides the part numbers and quotes to units to order repair parts themselves. The 3rd Infantry Division Surgeon Cell is considering pre-scheduling medical maintenance support for select incoming 1st Cavalry Division units, but this has not been standard practice. 8th MLC is

available upon request for contact repair but should not be considered part of normal unit maintenance planning for RAF units whenever possible. (3) Class VIII funding must be provided in advance of arrival to AO Victory. Many units arrive with Class VIII inventories significantly diminished, believing that Class VIII shortages will be filled by deployment funding upon arrival and not fully appreciating the gravity of the theater they are entering. Currently, USAMMC-E, the Theater Lead Agency for Medical Materiel (TLAMM), is executing the Class VIII mission in support of AO Victory units, however, this is expected to become an 8th MLC mission by FY25. These common shortfalls of deploying RAF units to arrive medically ready could have disastrous consequences as the MMB does not have the flexibility or capacity to meet all demands in the event of crisis.

IMPLICATIONS OF KNOWN STUDY LIMITATIONS

Figure 10, Unit Mission Load Expressed as a Percentage and Figure 11, Medical Mission Support Quantified by Type, contain known limitations. In terms of contributions, the method of analyzing unit contributions by mission line also fails to account for the routine, yet essential, support provided from home station. Figure 11 indicates the second most performed mission is the CRT, performed by 8th MLC at 35 missions in 24 months. This figure fails to account for the number of AO Victory and USAREUR-AF units which elect to bring assigned medical equipment for servicing to the 8th MLC maintenance bay, on USAG Baumholder. If these delivered equipment totals could be included within the analysis, the CRT mission count would approximately double. These figures also fail to account for 8th MLC's garrison support mission and internal servicing of 30th Medical Brigade equipment which includes sister 421st MMB units, a Field Hospital, a Medical Augmentation Detachment, and two Forward Surgical Resuscitation Teams. In the 20 months from 1 April 2022 to 30 November 2023, 8th MLC processed and distributed $1.92 million in Class VIII (4,539 lines) to AO Victory and other USAREUR-AF units from home station; this support is not accounted for within this analysis. Knowing this, the true unit mission load for 8th MLC is substantially higher than the data projected in Figure 10 – Unit Mission Load Expressed as a Percentage, with corresponding fluctuations of Figure 6 – Missions by Doctrinal Medical Function Expressed as a Percentage, and Figure 7 – Missions by Warfighting Function Elements Expressed as a Percentage.

Likewise, HHD's unit mission load is substantially higher than data suggests. HHD carries the considerable burden of medical mission command. Of primary importance for medical support operations, the Battalion headquarters oversees all aspects of planning and execution for Relief-In-Place / Transition-of-Authority (RIPTOA) of RAF medical units in AO Victory. Executing the Battalion higher headquarters role of transitioning units into and out of theater places a significant demand upon Battalion staff, which cannot be easily quantified. Much of the medical command and control function occurred and continues to occur from home-station via the grinding trifecta of Defense Service Network (DSN) phone lines, Microsoft Teams meetings, and Outlook emails. For HHD, the unit workload figure of missions executed off home-station is a poor metric to judge success or productivity, whereas the summation of 421st MMB mission execution is a better representation.

Within HHD, the MTOE of SPO staffing does not align with medical mission workload. Per Figure 7 – Missions by Warfighting Function Elements Expressed as a Percentage, 64% of missions fall within the Protection Warfighting Function, whereas 28% fall within the Sustainment Warfighting Function. Meanwhile, the FY24 MTOE for the MMB aligns 25% of the SPO MTOE positions against the observed 64% of Protection missions, while 71% of the SPO MTOE positions are aligned against the observed 28% of Sustainment Missions load. Put another way, 7 MTOE Soldiers executed medical command and control for 175 missions, while 20 MTOE Soldiers executed medical command and control for 78 missions. There is a clear imbalance, which only increases when considering the realities of painful personnel shortages against MTOE positions. Data suggests that FHP staffing should increase to be equally staffed with the MEDLOG and MEDOPS section. Further this medical MTOE construct should not simply prepare for LSCO, but also the prelude to LSCO, where the FHP mission set is likely to outpace the HSS, as observed in crisis Europe. In the meantime, MEDOPS personnel supplement FHP operations as needed, but that luxury may not exist in a future LSCO environment where all hands are required.

MMB DESIGN

The medical mission to SPO section staffing ratio issue provides greater insight into the shortcomings of MMB design. It is impossible to effectively design a standard MMB headquarters staff MTOE without first establishing a standard for subordinate unit types assigned in both type and quantity. The HHD, MCAS, MLC, and PM Dets consistently align to MMBs, whereas COSC, MDVS, and MCGA unit types vary by active duty MMBs and Medical Brigades, with considerations for basing decisions. This source of variation partially derives from a command authority debate, where O-5 commands of the COSC and MDVS could create challenges for the overall O-5 MMB Battalion Commander. For 421st MMB, these challenges have been minimal. Conversely, there are substantial advantages of aligning the COSC and MDVS to the MMB, primarily attributed to the nature of launching small team medical support missions as a routine action, and the corresponding requirement to build a functionally

deep understanding of the assigned area of operations.

The MMB concept in execution suffers further when reviewing ADP 5-0, The Operations Process, which states that "Commanders avoid exceeding the span of control of a subordinate headquarters when task-organizing… [as] increasing the number of subordinate units increases the number of decisions the commander must make, and that may decrease agility." 7 Conventional best practice observes that span of control is optimal at three to five subordinate units, with a maximum found at seven subordinate units. 421st MMB currently exceeds that maximum, with eight subordinate units, as do other Active Duty MMBs. If the current 421st MMB experience, in crisis Europe, is viewed as a model for a prelude to LSCO, and the medical mission load of LSCO will absolutely surpass all prelude mission loads, then our MMBs can expect sharp learning curves for open warfare. The majority of 421st MMB subordinate units deploy on a small-teams basis (MLC, PM, COSC, MDVS). This substantially increases the amount of medical mission planning, tracking, and support requirements. For LSCO, medical leaders should seek to maintain the optimal three to five subordinate unit task organization as much as feasible, especially for any mobile MMB operating from the Division level, as this will translate to roughly 20 small medical team operations. OPLANS which assign 20 or more subordinate units to an MMB are operationally untenable and set grounds for medical mission failure. What may have worked during decades of counterinsurgency (COIN) operations will not suffice in a pre-LSCO or LSCO environment. The 421st MMB data and experience in crisis Europe suggests that MMBs operating with eight or more task organized subordinate units in LSCO will struggle at best and at worst will become ineffective due to decreased medical command and control agility. Decision points based on the number and type of assigned subordinate units should be considered, where either MMB staff is augmented, or an additional MMB in theater is required. Finally, a basis of allocation of subordinate units by mission load versus the doctrinal number of personnel supported approach should be contemplated.

MEDICAL MISSION HURDLES IN EUROPE

There are many challenges to MMB mission execution ranging from understanding of the complex FHP mission sets to digital communication and coordination among distant headquarters. Executing USAREUR-AF medical support requires a whole-of-MMB-staff approach given the numerous unique operating requirements across Europe and Africa. These requirements include creation of NATO orders for each Soldier, mission approval in the Aircraft and Personnel Automated Clearance System (APACS), navigation of customs issues, coordination of cross international border linehauls, and occasionally official passports depending on the country. However, easily the leading challenge for medical mission execution, impacting nearly each of the 274 medical support missions analyzed here, is the Defense Travel System (DTS) and the associated Army method of funding temporary duty (TDY) travel. The vast majority of MMB missions are executed by small teams of two to four Soldiers on TDY, booked through DTS. Currently, the customer unit (typically Brigade-level) pays for their requested medical support missions, with supporting MMB personnel cross-organized to the customer Line of Accounting (LOA) to receive mission funding. Each customer unit or USAREUR-AF exercise has a unique line of accounting, which at any given time may or may not have sufficient funds to support mission execution. The sheer volume of staff hours spent negotiating the hurdles of DTS among each separate requesting customer command is wasteful at best and is a real problem for limited warfare support. The challenges of DTS management should not be shrugged away, as EAB medical teams will continue to deploy within the conflict continuum using this system.

Seeking change to the global Army DTS system is beyond the scope of this article. However, an attainable change is called for within our forward deployed AMEDD community. Though not addressing the problem in full, consideration should be given to the creation of an LOA, held at the Division or Corps Surgeon level, exclusively for funding Echelon Above Brigade (EAB) medical support requests. Changing the funding method would necessitate Division or Corps approval to obtain EAB medical support, translating to efficient application and direction of EAB medical assets. Through Division or Corps needs analysis, multiple Brigade and below customers could benefit from a single EAB-asset mission, rather than the current 'one LOA, one customer, one mission' method. As an example, a Division or Corps funded EAB MLC CRT mission could visit multiple Divisional Forward Operating Sites (FOS) to service medical equipment on a Division published schedule. This concept could be applied with efficiency to all programable preventative medical functions including COSC RRCs, COSC HRTs, MLC CRTs, and even dental readiness augmentation. Additionally, EAB medical units could be task organized to V Corps, consistent with 12 CAB and 2CR, via a suitable command relationship, allowing for substantially improved medical responsiveness for AO Victory Soldiers.

CONCLUSION:

Within crisis-Europe, the 421st MMB received and executed a new medical support mission every 1.903 business days over the last two years, creating a high OPTEMPO environment. The mission data shared indicates that Force Health Protection missions (64%) are the preponderance of the MMB workload; Health Service Support (28%), Medical Command and Control (8%). This significant finding has educational and advocacy implications for how the AMEDD is educating Company-grade leaders. 421st MMB has responded with

a FHP Customer Guide to assist units throughout Europe in their mission planning. Full understanding of FHP mission sets is required by every echelon for successful execution, from requestor through each higher headquarters.

Several conclusions can be drawn from the larger data set. 8th MLC and HHD primarily execute theater medical support from home station, therefore their true contribution to USAREUR-AF is much higher than data suggests. Observed Force Health Protection mission requirements do not align to HHD SPO staffing. AO Victory also has known limitations for medical support, which deploying RAF units should be prepared to encounter. Coordinating mission support by small team for AO Victory is a taxing endeavor, where revised funding methodologies within DTS could improve mission support execution and create avenues for efficiency within Division and Corps directed EAB support.

Medical OPTEMPO will increase exponentially in a LSCO environment where span of control is expected to be a significant factor, potentially leading to exhausted MMB headquarters if not appropriately task organized. Attachment of additional EAB medical units to an MMB headquarters must be accompanied by HHD staffing augmentation to match the additional command and control requirements and a decision point for when additional MMB headquarters become a necessity. 40% of 421st MMB medical missions support AO Victory, 32% supports USAREUR-AF assigned units, and 28% support USAREUR-AF exercises, inclusive of Global Health Engagements (GHEs). Finding medical success in this theater necessitates deliberate, thoughtful, and concise command priorities.

The final stage of this three-part project was sharing a picture of the current European medical operating environment with the greater Army Medical Department professional community. This picture was intentionally presented in the format of a research report as "this information should drive evidence-based decisions."8 We anticipate the data, challenges, and lessons learned shared here will serve to educate and inform AMEDD leaders. The bottom line is that 421st MMB is making Army Tactical Medicine work in Europe and Africa, via small team deployments, one medical support mission at a time.

Author's Note: The data set is available by request from valid army.mil email addresses.

References

1. "Joint Concept for Integrated Campaigning," Joint Chiefs of Staff, accessed February 4, 2024,
2. https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/joint_concept_integrated_campaign.pdf
3. "The Army In Military Competition: Chief of Staff Paper #2," Headquarters, Department of the Army, accessed February 4, 2024,
4. https://api.army.mil/e2/c/downloads/2021/03/29/bf6c30e6/csa-paper-2-the-army-in-military-competition.pdf
5. Department of the Army. Army Health System (AHS) Doctrinal Smart Book (Washington, DC: Department of the Army, 2023) 86.
6. Department of the Army. Army Health Systems, FM 4-02 (Washington, DC: Department of the Army, 2020) 1-5.
7. Department of the Army. Army Health Systems, FM 4-02 (Washington, DC: Department of the Army, 2020) C-3.
8. "421st MMB FHP Customer Guide," MS Teams, accessed February 4, 2024, https://dod.teams.microsoft.us/l/team/19%3adod%3afc8f4f5604b94fd78629d554c2b6c9b0%40thread.tacv2/conversations?groupId=3e1c6e4a-c14d-4350-ad54-e0e9bef1b74a&tenantId=fae6d70f-954b-4811-92b6-0530d6f84c43
9. Department of the Army. The Operations Process, ADP 5-0 (Washington, DC: Department of the Army, 2019) 2-4.
10. Delorenzo, Robert & Mabry, Robert L. "Challenges to Improving Combat Casualty Survival on the Battlefield." *Military Medicine* 179, no. 5 (2014): 477-482.

Physician Leadership: Does Military Service increase a Physician's Desire to be a Physician Leader

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ABSTRACT

There is a leadership crisis in the civilian healthcare system. Despite the benefits of physician participation in healthcare system leadership and management roles, few are answering the call. In contrast, many military physicians overwhelmingly want to serve inleadership roles upon their leaving military service. This study surveyed Active-Duty Air Force, Army, and Navy General and Orthopaedic Surgeons to explore what characteristics of their military service contributed most to desiring future leadership roles. The findings suggest a relationship between military service and fostering a desire to pursue leadership opportunities.

INTRODUCTION

People decide to join the military for many reasons. For some, it's patriotism and love for their country. For others, it's the financial, educational, and career opportunities that the military provides. Despite the various reasons someone may decide to become a physician in the military, the common thread throughout their service is that the military will require them to be more than just physicians. They will also be military officers, and inherent with this title is training for and the responsibility of leadership.[1]

Contrary to the military, the civilian health sector does not require physicians to be physician leaders.[2,3] Despite the recognition that physician leadership in key hospital executive roles improve quality care, there is an absence of physicians that desire these roles.3 Common reasons cited are that leadership and management roles are distractions from patient treatment and care, they are incongruent with their psychological identity, or their general lack of experience in leadership roles.[4]

This study surveyed Air Force, Army, and Navy Active Duty General and Orthopaedic Surgeons on their exposure to leadership roles, sentiment towards those roles, and their desire upon leaving military service to continue serving in leadership positions. The purpose of this study is to identify factors that may contribute to deciding to pursue leadership opportunities in the military and upon leaving military service. The identification of these factors would assisthealth care system leaders in developing physician leaders and facilitating increased physician representation within both civilian and military healthcare leadership positions. The authors hypothesize that physicians who are serving in the military will have a heightened desire to serve in leadership roles when exposed to leadership opportunities and upon leaving military service within the civilian healthcare environment.

METHODS

We invited all Active-Duty Air Force, Army, and Navy General and Orthopaedic Surgeons to complete an online survey questionnaire (n=699). The survey was sent to specialty leaders for each respective service and disseminated to the service members. There were two reminder emails sent and survey responses were blinded. The study data was collected and managed using REDCap (a secure web application for building and managing online surveys and databases) hosted at Vanderbilt University Medical Center.[5,6]

Demographic information collected included age, gender, surgical specialty, residency graduation year, and branch of service. Survey questions included the types of commonly available hospital and operational leadership positions held (Question 1). These consisted of Residency Director, Fellowship Director, Service Chief, Department Chief, Deputy Hospital Commander, Hospital Commander, and Operational/Unit Commander. If one of these was held, they were then asked if they aspired for the leadership position (Question 2), if the position was competitive (Question 3), if formal training was provided for the leadership position (Question 4), length of time position was held (Question 5), why they left the leadership position (Question 6), the rating of the impact of the leadership experience on one's overall career (Question 7), and likelihood one would seek out additional leadership opportunities as a results of their

experience (Question 8). Responses for Questions 2-4 were collected using "Yes/No" answer options, while responses for Questions 7-8 were collected using a five-point Likert scale with choices ranging from very negative=1 to very positive=5. For further reference, the survey can be seen in Appendix 1.

Statistical analysis was performed using Excel, Microsoft Office 365 (Microsoft Corp., Redmond, WA, USA) and IBM SPSS Statistics for Windows, version 28 (IBM Corp., Armonk, N.Y., USA). Chi-Square Tests were run comparing survey responses and the likelihood of answering yes to aspiring to be in leadership if/when one transitioned to civilian practice.Statistical significance was set at $\alpha < 0.05$.

RESULTS

The total completed survey questionnaires were 192, equaling a response rate of 27%. General Surgeons (70%, n=134) and individuals from the Army (46%, n=87) represented the highest percentage of surveys completed (Table 1). Of the survey questions, residency graduation year had the highest correlation with desiring future civilian leadership roles ($p < .01$). The respondents with a more recent residency graduation year (2014 to Present) desired to serve in leadership positions over their military peers with older residency graduation dates.

Of the 192 survey responses, only 25% (n=47) of the respondents had not yet served in any hospital or operational leadership roles during their military service (Table 2). However, no matter one's exposure to a hospital or operational leadership experience, 53% (n=102) still reported that they desired future civilian leadership. Of those that had served in leadership positions, most reported that the leadership opportunity had a positive impact on their career, and they would seek additional leadership opportunities because of the role (Table 3). The average reported rating for leadership impact on overall career was 3.95 and 3.5 for likelihood of seeking additional leadership opportunities. Deputy Hospital Commander had the highest overall ratings in both impact on career and likelihood of seeking additional leadership opportunities. For those that had served in this role, the average years of medical practice was 9.7 and a range of 5-15 years after completion of their training (Table 4).

DISCUSSION

Service in the military offers physicians early in their careers increased opportunities to lead and lead earlier in their career than their civilian counterparts. Our analysis suggests that early leadership exposure, whether in hospital or operational roles, motivates military physicians to desire leadership positions even upon their transition to the civilian sector. Furthermore, an average self-rating of "positive" for the impact of leadership roles on one's career suggests that leadership experience is seen as a valuable self-development opportunity.

Our results follow previously published discussions on military physician population demographics.7 Most military physicians do not spend their entire career in the military, creating a younger average age for military physicians than their civilian counterparts.7 As of 2018, among the 246 military graduate medical education (GME) programs, only 25% were led by colonels (O-6s), while 20% were led by majors (O-4s).[7,8] While the average age of all civilian residency program directors have not been published, there is published data on ophthalmology residency program directors. Of the 116 civilian ophthalmology residency program directors surveyed, the average age upon appointment was 43 years old.[9] This age is much closer to the average age of reaching the rank of colonel (O-6) or senior lieutenant colonel (O-5), rather than major (O-4). Furthermore, 5 of the 8 leadership position categories had military physicians in leadership roles immediately following residency or fellowship graduation (Table 4). This early leadership exposure allows military physicians the

Table 1. Demographics

	N	Mean	Standard Deviation
Age	193	42	7.91
Residency Graduation Year	193	2018	7.54
	N	**%**	
Women	45	24%	
Men	146	76%	
General Surgeons	134	70%	
Orthopedic Surgeons	57	30%	
Army	87	46%	
Navy	86	45%	
Air Force	17	9%	

Table 2. Respondent Results

LDR Positions	N	%	Reason for leaving LDR Position	N	%	LDR Descriptive Variables	N	%
Residency Director	12	6%	PCS (New Assignment)	72	29%	Need for Competition (Yes)	87	35%
Fellowship Director	5	3%	Left the military	15	6%	Aspiration for Position (Yes)	117	48%
Service Chief	71	37%	Promoted	29	12%	Formal Training Provided (Yes)	45	18%
Department Chief	52	27%	New LDR position	44	18%	Average Time Position Held (Yrs.)	1-3	59%
Deputy HC	7	4%	Resigned from LDR Position	38	16%	Average Years of Medical Practice (Yrs.)	6	N/A
HC	4	2%	Still occupying	73	30%			
Other not listed	62	32%	Other	18	7%			
Operational/Unit	33	17%						
None	47	24%						
LDR= Leadership; HC=Hospital Commander; Yrs= Years; PCS= Permanent Change of Station								

Table 3. Respondent Assessment of Leadership Opportunity (Likert Scale 1-5)

LDR Positions	Rating on Career Impact		Likelihood of Seeking Additional LDR Opportunities as a Result of Position	
	Mean	Standard Deviation	Mean	Standard Deviation
Residency Director	4.17	1.19	3.33	1.49
Fellowship Director	4	1	3.6	0.89
Service Chief	3.66	1.09	3.09	1.5
Department Chief	3.71	1.23	3.38	1.49
Deputy HC	4.71	.75	3.85	1.46
HC	3	2.30	3.5	1.91
Other not listed	4.05	.99	3.55	1.26
Operational/Unit	4.33	1.08	3.72	1.39
LDR= Leadership; HC=Hospital Commander				

Table 4. Years of Practice upon LDR Role Assumption

LDR Positions	Mean	Standard Deviation	Range
Residency Director	5.6	3.05	2-10
Fellowship Director	10.2	7.46	1-19
Service Chief	3.9	2.91	1-13
Department Chief	4.3	3.60	1-14
Deputy HC	9.7	3.59	5-15
HC	12.8	5.31	6-17
Other not listed	5.1	3.62	1-20+
Operational/Unit	5.8	4.47	1-20+
LDR= Leadership; HC=Hospital Commander			

unique opportunity to develop their identity asleaders early and to see the positive organizational impact that serving in a leadership role canhave.

Despite the military's increased leadership opportunities for physicians early in their career, retention rates for the early career military physician demographic are low. A 2020 survey of Army Medical Corps Officers (MCO) at the ranks of captain (O-3) and major (O-4) "Indicated that they are unlikely to stay on active duty after their ADSO (active-duty service obligation) is complete…[And] less than 15% of MCO within 2 years of their ADSO indicate they will likely stay on active duty longer than expected."[7] A top reason cited for dissatisfaction was a lack of "administrative support."[7]While early-career military physicians have the opportunity to assume leadership roles earlier than their civilian counterparts, the level of responsibility they are entrusted is not sufficient to address their administrative needs. The military's healthcare system operates on a hierarchical structure, and rather than remaining in the military to tackle these issues, many choose to separate upon completing their service obligation. This creates a vacuum at the highest levels of military health care administration for physician representation. By increasing physician representation in the highest leadership positions, they could better streamline processes, better align administrative efforts to support physician needs, and potentially increase retention rates. It has been shown that when physicians are led by other physicians, there is increased trust and respect by physicians for the leadership team.[10] However, even if military retention rates are not affected by this change, the civilian health sector would benefit from increased physician representation in leadership roles being filled by prior service members. Survey responses showed that no matter one's military leadership experience, 53% (n=102) of all respondents answered they desire leadership roles upon their civilian transition.

There are several limitations to this study. The first being its generalizability to the larger military physician population. Our survey included only general and orthopaedic surgeons. While we did not sample other specialties, our aim was to provide the foundation for further investigation. However, a 2020 leadership study completed at a military internal medicine residency program showed that residents felt that leadership training was vital, and it helped them "understand the importance of their personal roles as leaders," indicating a desire for leadership in more than just surgical specialties.[11] The second limitation is asking military physicians their views toward leadership. By virtue of joining the military, physicians may already have an innate desire for leadership roles. The final potential limitation is the direct comparison of leadership roles between civilian and military health systems. While there are differences between the military health system and civilian healthcare sector, there are many similarities in the leadership skills needed for managing day to day operations, particularly in GME. [8]

CONCLUSION

Our findings suggest that service in the military motivates physicians to become physician leaders. The military environment provides everyone that serves with exposure to discipline, leadership training, clear organizational structure, and a professional identity of serving as part of something larger than oneself. It also allows many the opportunity to lead before they would have received the chance in the civilian sector. These factors ultimately appear to lead military physicians to have a heightened desire to participate in leadership roles and be physician leaders.

References

1. Will JS, Malave B. Military Physicians Are Not Just Physicians in the Military: Using Leadership Training in Military Graduate Medical Education to Assure Mission Success. *Mil Med*. 2019;184(3-4):61-63. doi:10.1093/milmed/usy423

2. Stoller J, Goodall A, Baker A. Why The Best Hospitals Are Managed by Doctors. *Harvard Business Review*. Published 2016. Accessed June 15, 2023. https://hbr.org/2016/12/why-the- best-hospitals-are-managed-by-doctors

3. AMN Healthcare. Room to Grow: Trends in Hospital and Health System Physician Leadership.; 2020.
4. Bäker A, Bech M, Geerts J, et al. Motivating doctors into leadership and management: A cross-sectional survey. *BMJ Leader*. 2020;4(4):196-200. doi:10.1136/leader-2019-000181
5. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform. 2019;95. doi:10.1016/j.jbi.2019.103208 Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)-A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381. doi:10.1016/j.jbi.2008.08.010
6. Marble WS, Cox ED, Hundertmark JA, Goymerac PJ, Murray CK, Soderdahl DW. U.S. Army Medical Corps Recruitment, Job Satisfaction, and Retention: Historical Perspectives and Current Issues. *Mil Med.* 2020;185(9-10):E1596-E1602. doi:10.1093/milmed/usaa094
7. Servey JT, Hartzell JD, McFate T. A Faculty Development Model for Academic Leadership Education Across A Health Care Organization. *J Med Educ Curric Dev.* 2020;7:238212052094887. doi:10.1177/2382120520948878
8. Kloosterboer A, Yannuzzi NA, Gedde SJ, Sridhar J. Residency Program Directors of United States Ophthalmology Programs: A Descriptive Analysis. *Am J Ophthalmol*. 2020;209:71-76. doi:10.1016/J.AJO.2019.09.003
9. Lynne Jackson J, Lynne J. Factors That Influence Physicians to Assume Leadership Roles: A Focus on Clinical Integration. Vol 120.; 2017. http://digitalcommons.wku.edu/diss/120
10. True MW, Folaron I, Colburn JA, Wardian JL, Hawley-Molloy JS, Hartzell JD. Leadership Training in Graduate Medical Education: Time for a Requirement? *Mil Med*. 2020;185(1-2):E11- E16. doi:10.1093/milmed/usz140

Appendix I:

Leadership Survey- Active Duty

Please complete the survey below.

Age (in years)	_____
Gender	◯ Male ◯ Female ◯ Other/Non-Binary
What is your Specialty?	◯ Orthopaedic Surgery ◯ General Surgery
What is your Branch of Service?	◯ Air Force ◯ Army ◯ Navy
Residency	◯ Military ◯ Civilian
Year Graduated Residency	_____
How many YEARS did you owe the military at the conclusion of your residency? (Do not include additional years owed due to fellowship.)	◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10 ◯ 11 ◯ 12 ◯ 13 ◯ 14 ◯ 15 ◯ more than 15
Have you completed a fellowship?	◯ Yes ◯ No
What kind of fellowship did you complete?	◯ Military ◯ Civilian
How many ADDITIONAL YEARS did you owe the military after the completion of your fellowship? (Only include years added to your commitment due to your fellowship.)	◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6

Have you served in any of the following Service/Department/Hospital Level Leadership positions? (check all that apply)

- ☐ Residency Program Director
- ☐ Fellowship Director
- ☐ Service Chief
- ☐ Department Chair
- ☐ **Clinic or Hospital Deputy Commander**
- ☐ **Clinic or Hospital Commander**
- ☐ Other Clinical Leadership not listed
- ☐ Operational Unit Leadership/Commander
- ☐ None

When you became Residency Program Director...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership **experience?** _____

When you became Fellowship Director...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership **experience?** _____

When you became Service Chief...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career?

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

When you became Department Chair...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

When you became Clinic or Hospital Deputy Commander...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

When you became Clinic or Hospital Commander...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

What was the leadership position you held NOT listed above? _____

When you assumed This Position...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

What OPERATIONAL UNIT LEADERSHIP POSITION did you hold? (FRST Commander, etc.) _____

When you became an Operational Unit Leader/Commander...

How many years of practice had you completed when you assumed this position? _____

Did you aspire for this position? _____
Did you compete for this position, i.e. formal application process, interview, etc? _____
Did you receive any formal training related to your leadership position, i.e. required course? ___
How long did you hold this position? ____

Why did you leave this position? (select all that apply)

_____

How would you rate the impact of this leadership experience on your overall career? _____

What is the likelihood you would seek out additional leadership opportunities as a result of this leadership experience? _____

Do you aspire to be in medical leadership if/when you transition to civilian practice?
- ◯ Yes
- ◯ No

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