

The Musculoskeletal Imperative

Enhancing Combat Capability through Effective Injury Management

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Maj. Gen. Michael Talley, the former head of the Army's Medical Center of Excellence, issued a clarion call during a recent maneuver warfighter conference panel at Fort Moore, Georgia: "It will take everyone to clear the battlefield as quickly as we can when we're talking about the scale of 21,000 casualties in corps warfighting. That's reality. How do you keep going?" By statute, the Selective Service must deliver its inductees to the military within 193 days from activation of the draft.¹ Between these two waypoints, we must fight with "the Army we have," regenerate combat power wherever possible, and sustain operations until our personnel and materiel generative capacities catch up.² Against this stark backdrop, a harsh truth of warfare remains: disease nonbattle injury (DNBI) historically results in a significantly greater number of casualties than combat-related injuries. During World War II, DNBI produced nearly five times more casualties than battle injuries.³ In the early phase of Operation Iraqi Freedom, DNBI accounted for around 75 percent of all hospitalizations.⁴ If we imagine our next conflict as a muddy, bloody war of attrition, nonbattle injury becomes even more unacceptable.

Among the subcategories of DNBI, musculoskeletal injuries (MSKI) pose a constant and possibly growing threat to readiness. The Army's ability to regenerate and maintain combat power is heavily dependent on its ability to manage MSKI. The Army must (1) place a new emphasis on MSKI, standardizing care across echelons using a common analytical framework; (2) establish a quality-assurance, quality-control process that ensures proficiency; and (3) integrate MSKI treatment at echelon in a way that parallels the scaled capabilities within the Joint Trauma System.

The Strategic Burden of MSKI

MSKIs present a significant challenge to readiness across the spectrum of conflict. In March 2019, MSKIs accounted for around four brigade combat teams' worth of soldiers in the active component deemed medically nondeployable.⁵ During the Global War on Terrorism, at least 30 percent of all medical evacuations from Iraq and Afghanistan were for DNBI, including spinal pain. What's more, more than 80 percent of the service members evacuated



U.S. Army Reserve Spc. Neil Blue (left) and Lt. Col. Tola Akomolafe, both from the 311th Medical Surgical Detachment, perform physical therapy on 1st Lt. Briana Rodriguez at Fort McCoy, Wisconsin, 19 August, 2023, during Exercise Global Medic. Global Medic is a collective training exercise in which forces from all components along with joint and international partners test their medical equipment, systems, and procedures to help prepare for future conflicts. (Photo by Sgt. Mikayla Fritz, U.S. Army)

for MSKIs failed to return to duty—the worst return to theater rate outside of psychiatric conditions and battle injuries.⁶ MSKIs are also the leading cause of attrition within an enlistee’s first forty-eight months of service, factoring into 91 percent of all disability discharges.⁷ Given the limited number of physically fit, eligible recruits, the increasing weight of combat loads borne by soldiers on the modern battlefield, and the potential need for a draft to offset losses in a large-scale combat operation (LSCO), the issue of MSKI becomes central to any discussion on America’s long-term defense strategy.⁸ Addressing MSKI is not just a health concern; it’s a critical factor in maintaining our national defense capabilities.

Our Doctrinal Charge

Army Techniques Publication (ATP) 3-94.4, *Reconstitution Operations*, specifies, “medical personnel

identify RTD [return to duty] patients as early in the evacuation chain as possible,” and “the goal of medical efforts in the regeneration site is to maximize RTD.”⁹ Reconstitution also lists RTD forecasting as part of the external assessment that a different unit conducts on behalf of the attrited unit.¹⁰ To military practitioners, these tasks seem straightforward. Yet, for MSKI, they aren’t always clear-cut issues. During conflicts in Iraq and Afghanistan, “sprain” injury was the most common cause of MSKI, and “overuse conditions” were the second most common reason for medevac related to MSKI.¹¹ Particularly regarding back pain and spinal injury, “sprain” is a nonspecific term lacking firm diagnostic criteria.¹² “Overuse conditions” are often overdiagnosed and used as a catch-all when a clear anatomical insult is absent. What’s more, different types of “overuse conditions” and “sprains” have different recovery timelines—one soldier with “overuse knee pain”

might recover in six to eight weeks, and another might recover in three to four months. In both instances, there is a lengthy RTD timeline. We should be absolutely clear when overuse conditions are truly present, and this requires a high level of diagnostic capability in our medical providers.

Regrettably, the majority of our medical providers lack sufficient training in musculoskeletal and orthopedic triage, assessment, and treatment. An infantry battalion is equipped with a physician assistant and when deployed, with a battalion surgeon. Those who have completed the Interservice Physician Assistant Program receive around ten credit hours in orthopedic training, mainly focused on surgical management.¹³ Similarly, unless a battalion surgeon has specialized in orthopedic surgery or sports medicine, their orthopedic/musculoskeletal training is likely limited to ten to twelve credit hours.¹⁴ This shortfall in expertise is underlined by a 2007 military medicine study by John D. Childs et al., which found that only 18 percent of nonorthopedic military physicians in their sample passed a musculoskeletal competency examination.¹⁵

As a result of this deficit in knowledge and training, nonphysical therapists are more likely to rely on diagnostic

imaging to obtain a MSKI diagnosis.¹⁶ The problems here are twofold: (1) in the LSCO environment, every effort should be made to reduce the signal footprint as

part of force protection; and (2) diagnostic imaging often results in false positives.¹⁷ Prognosis and treatment that follow an inaccurate diagnosis is at a very low level of precision. To recap, we have inadequately trained individuals using technology with a significant logistical and

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electromagnetic footprint at high risk of misdiagnosing MSKIs and inaccurately forecasting RTD.

In light of these limitations, there is a significant chasm between what reconstitution requires and what Army medical providers are typically able to do. A simple response might be to train more physical therapists. However, there is only so much space at Fort Sam Houston and so many positions available at the Army-Baylor program. To account for this gap between Army-Baylor graduates and what holistic health and fitness (H2F) requires, the Army has increased its number of direct accession physical therapists. Yet, while every physical therapist is required to possess an entry-level doctoral degree and state licensure, there is still considerable variability in clinical practice. Physical therapists practice across a wide range of settings, and licensure doesn't guarantee orthopedic expertise but rather an ability to work as a generalist.¹⁸

Orthopedic practice across physician and nonphysician providers similarly demonstrates a lack of standardization, and troublingly, many invalid forms of clinical testing predominate.¹⁹ Orthopedic providers often use different terms and conflicting paradigms to describe and assess the same clinical entities, complicating communication regarding whether a soldier can RTD, what resources will be needed to facilitate RTD, and how long it will be before a soldier can RTD. In civilian and military orthopedic practice, these inconsistencies can lead to overtreatment and further legitimize orthopedic surgeries with questionable benefits beyond placebo.²⁰

Doctrinal Changes to MSKI Management

Clearly, if Army medicine is to accomplish the charge set forth in ATP 3-94.4, it must reform every aspect of MSKI management and demand a level of standardization of its MSK specialists. Standardization is a critical part of Army medicine that allows continuity of care at echelon. In trauma management, combat medics use the mnemonic MARCH PAWS (massive bleeding, airway, respiration, circulation, head and hypothermia, pain, antibiotics, wounds, and splinting) to guide assessment and tactical combat casualty care to guide initial treatment.²¹ Providers at higher echelons of care are trained in advanced trauma life support, the Combat Casualty Care Course, and other courses within the Joint Trauma System.²²

ATP 4-02.5, *Casualty Care*, specifies a number of different triage and treatment pathways for combat and operational stress control (COSC), dental care, and concussion care. Conspicuously absent in the military health system doctrine is any detailed instruction on MSKI management. In fact, there are no algorithmic depictions of MSKI triage and RTD decision processes in Army doctrine.²³ COSC is a logical point of comparison, and the many parallels between COSC and MSKI management are instructive. Five behavioral health professional disciplines and two enlisted specialties support the COSC mission.²⁴ All are trained using the BICEPS (brevity, immediacy, contact, expectancy, proximity, and simplicity) concept of combat operational stress reaction management.²⁵ It is expected that over 95 percent of soldiers who experience combat and operational stress reactions will return to duty.²⁶

Just as physical therapists approach the treatment of MSKI with advanced strategies, COSC units are strategically positioned to optimize their impact, ensuring a higher rate of return to duty.²⁷ Echoing the principles of COSC, the management of MSKI involves a collaborative, multidisciplinary approach that transcends the boundaries of any single profession. However, there is a notable lack of standardized guidelines for both orthopedic and nonorthopedic medical practitioners to follow. The Army's need for a substantial rate of RTD from MSKI cases is critical. Adopting a method akin to COSC's successful practices is not only logical but also critical. In the same vein as COSC's BICEPS and the "five Rs" (reassurance, rest, replenish, restore, return) principles, MSKI demands a unified language and consistent protocols for triage and assessment.²⁸ We propose a foundational framework to inform future doctrine and training in this area in the following sections.

Rapidly Reversible Conditions

In 2021, active-duty soldiers sustained over five hundred thousand musculoskeletal injuries. Counting diagnosis codes in the electronic health record, the Army Public Health Center's report classified over 86 percent of these injuries as "cumulative microtrauma" injuries, with the remainder classified as "acute traumatic injuries."²⁹ Some diagnostic codes, such as those for bone

stress fracture, refer explicitly to conditions that directly result from repetitive, sub-threshold loads on musculoskeletal tissue that eventually lead to anatomic disruption. However, many nonspecific diagnostic codes are also included in this count. These include codes based on symptoms such as “low back pain” and “runner’s knee.”³⁰ In reality, many of these codes do not correspond to specific disorders. Instead, they are catch-all terms for musculoskeletal symptoms that either lack a distinct pathology or cannot be effectively diagnosed and treated based solely on X-ray, magnetic resonance imaging results, or laboratory tests.³¹

The narrative that follows these reports is that many injuries in the Army are a result of repetitive microtrauma due to overtraining or resultant from military training exposure. While cumulative microtrauma injuries are certainly a relevant portion of MSKIs (particularly during initial entry training), a third category of injuries is overlooked through this classification scheme. For this argument, we’ll refer to these conditions as “green flag conditions.”³²

Green flag conditions are clinical entities that mimic stereotypical orthopedic injuries (e.g., “bursitis,” “sciatica,” “impingement”).³³ Instead of requiring multiple treatments over several weeks to months to improve, a green flag condition rapidly improves in response to a specific, single exercise, oftentimes on the first day of treatment. In contrast to sprains and strains, green flag conditions resolve quickly, allowing the soldier to RTD without significant time loss.³⁴ Green flag conditions are present in over 70 percent of all people who report some type of spinal pain (neck, mid back, or low back), and though comparatively less common in the extremities, represent a significant proportion of complaints.³⁵ Between 2021 and 2022, a majority of patients treated at the Brigade Physical Therapy Clinic in the 173rd Airborne Brigade were diagnosed with green flag conditions. Though this was in garrison, many if not most of these injuries resulted from military training events such as airborne operations and long-distance movements.

COST REDUCTION USING MDT-TRAINED STAFF VS. USUAL CARE FOR LOW BACK PAIN



51.48%⁵⁰
COST SAVINGS

Image from Ronald Donelson et al., “The Cost Impact of a Quality-Assured Mechanical Assessment in Primary Low Back Pain Care,” *Journal of Manual & Manipulative Therapy* (19 May 2019).

In a LSCO environment, it is improbable that these injuries would suddenly stop occurring.

Soldiers, medics, and providers can identify the presence of a green flag condition through a standardized mechanical assessment. This assessment uses repeated joint and spinal movements as well as sustained bodily positions to clarify the clinical picture and accurately classify a musculoskeletal injury or pain complaint. MSKIs may be classified as green flags, structurally compromised (e.g., a shoulder dislocation or ACL tear), recovering trauma (e.g., a sprain or strain), joint or muscle dysfunctions (e.g., tissue abnormalities that require remodeling through exercise), or as resulting from other disease processes. Each classification has a specific prognosis and course of treatment.

The standardized mechanical assessment, known as mechanical diagnosis and therapy (MDT), is diagnostic and therapeutic. When practiced by trained examiners, MDT is highly reliable in classifying spinal and extremity pain—unlike other commonly used orthopedic examination processes.³⁶ In the 75th Ranger Regiment, MDT has been an integral part of injury prevention and orthopedic assessment for decades.

Though perhaps not widely known, it is because of the Ranger Regiment's success in using MDT as self-treatment that its pamphlet, "Joint PMCS: How to Find and Treat Your Own Pain," was incorporated into the Army's official fitness doctrine in chapter 17 of ATP 7-22.02, *Holistic Health and Fitness Drills and Exercises*.³⁷ MDT has demonstrated effectiveness in military medicine as treatment for MSKIs and as injury prevention.³⁸

therapists will have to triage, treat, and take off. Therapists using MDT have advantages in this environment. MDT emphasizes patient empowerment—patients are taught self-assessment and treatment, reducing reliance on medical providers to perform specialized procedures such as trigger point dry needling, taping, or joint manipulation/adjustments. Using MDT, providers give patients a movement

“ The ability to discern green flag conditions from true structural compromise will decrease the number of soldiers requiring medevac/casualty evacuation to the Role 2 and beyond. ”

Implications for LSCO and Home Station

MDT affords several advantages over other forms of orthopedic assessment in the LSCO environment. First, it requires no specialized equipment, which means no additional electromagnetic signal output. MDT practice is also scalable at echelon. Basic self-treatment principles (such as those from the Joint PMCS [Preventive Maintenance Checks and Services]) can be taught as “self-aid.” Platoon/Role 1 medics are capable of learning an abbreviated assessment that allows for rapid resolution and RTD and have demonstrated this capacity in the 75th Ranger Regiment and 173rd Airborne. Physicians and physician assistants at the Role 1 can use MDT to make more informed judgments and keep more soldiers in the fight. Moreover, the ability to discern green flag conditions from true structural compromise will decrease the number of soldiers requiring medevac/casualty evacuation to the Role 2 and beyond. In a contested environment where medevac (particularly aerial medevac) will be far less available, evacuating DNBI MSKI must be kept to an absolute minimum.

There are also benefits for physical therapists and other providers traditionally working in a Role 2 or Role 3. We can expect our enemy to utilize drones for continuous intelligence, surveillance, and reconnaissance of rear echelon support areas and effectively use fires to disrupt sustainment. A static Role 2 or Role 3 may become a thing of the past, and physical

prescription that resolves their MSK problem and a maintenance plan that prevents recurrence.

Outside of LSCO, MDT confers several additional benefits beyond the current standard orthopedic care. It is a guideline-recommended treatment for low back pain and knee osteoarthritis. In the private sector, quality-assured MDT spinal care resulted in significant cost savings and decreased surgical rates. If extrapolated to the military setting, this means fewer days lost to profile and fewer days lost in postoperative recovery. Most importantly, MDT allows health-care providers to develop a common operating picture of MSKI that simply and effectively communicates diagnosis and prognosis.

Beyond the confines of LSCO, MDT offers a multitude of advantages over conventional orthopedic approaches. Renowned for its effectiveness, MDT is a widely endorsed approach for managing common ailments such as low back pain and knee osteoarthritis, as substantiated by guidelines and research.³⁹ In the private health-care sector, implementing a standardized MDT approach in spinal care using certified clinicians has yielded substantial cost savings and significantly reduced the frequency of surgical interventions.⁴⁰ Translating these benefits to a military context suggests a potential reduction in the number of days soldiers are sidelined due to medical profiles or recovering from surgery. Crucially, MDT equips health-care professionals with a streamlined and cohesive framework for understanding and communicating the nuances of MSKI, encompassing both diagnosis and prognosis.

This unified approach enhances clarity and efficiency in managing these injuries, significantly benefiting military medical practice.

Rising to the Challenge

To effectively address the MSKI crisis, the Army must adopt a standardized approach to orthopedic care that mirrors the rigor and effectiveness of the Joint Trauma System protocols. This comprehensive strategy encompasses several critical elements: (1) MDT training and education at echelon, (2) uniform diagnostic and treatment protocols for MSKI, and (3) robust monitoring and quality-control measures. Each element forms a foundational part of this framework, with each subsequent component building upon the preceding one.

Squad level. Holistic health and fitness (H2F) integrators, formerly known as master fitness trainers, form the first line in this effort. This is because the Joint PMCS, when properly executed, can prevent injury, treat latent injuries, and identify “faults” for holistic health and fitness readiness experts to examine more closely.⁴¹ The Joint PMCS is akin to weapons maintenance. We train our soldiers on how to perform a functions check, take immediate actions, and properly maintain their materiel weapons systems. The Joint PMCS is the same for the human weapons system. This is a critical item in current doctrine. We would recommend ongoing collaboration between an expert MDT clinician and instructors in the U.S. Army Physical Fitness School for quality assurance and to integrate lessons learned from the field. We would also recommend enhancing the focus on the Joint PMCS during leader development courses and initial entry training to ensure the doctrine is part of everyday practice.

Platoon and company level. The first touch medical provider for a given line platoon is a military occupational specialty [MOS] 68W combat medic. In garrison and during combat operations, the platoon “doc” is often the first triaging member of the Army’s casualty care pathway. Regardless of the issue, “doc” is the first to take a look. It has been our experience that combat medics are frequently asked about MSKI management. Many soldiers want to avoid duty-limiting profiles or feel that visiting a medical provider is an admission of weakness. Systemic underreporting of MSKI is the result.⁴²

Given the myriad demands on combat medics’ time, it remains crucial that their annual training prioritizes managing battlefield trauma. However, to improve MSKI management, we propose adopting a streamlined, MDT-based algorithmic method. This approach simplifies the triage, assessment, and treatment of musculoskeletal injuries, enabling medics to deliver efficient and effective care in diverse scenarios. Units and/or professional military education courses should draw from the successful programs of instruction and algorithms in use at the 75th Ranger Regiment and 173rd Airborne.

Though physical therapy specialists (MOS 68F) aren’t attached to platoons or companies, equipping them with algorithmic MDT training can markedly enhance clinical efficiency across Role 2, H2F, and brigade physical therapy settings. The 173rd Airborne Brigade physical therapy clinic was able to enhance access to care using this model. For those unfamiliar with their MOS training, it is worth noting that both 68Ws and 68Fs have algorithm-driven protocol manuals. For 68Ws, these algorithms are found in U.S. Army Medical Command Pamphlet 40-7-21, *Algorithm-Driven Troop Medical Care*. The 68Fs receive a booklet in Advanced Individual Training known as the neuromusculoskeletal screening tool.⁴³

Battalion level. The battalion physician assistant plays a crucial role in medic training. While H2F-equipped brigades may alternately use an empaneled athletic trainer, we recommend training physician assistants in a minimal level of MDT proficiency to sustain ongoing medic training and enhance medical capability at the Role 1. A practitioner is considered minimally proficient in MDT upon completion of the McKenzie Institute USA’s certification process. This preliminary postgraduate course in MDT consists of five courses held over eighteen nonconsecutive days and culminates in a two-day credentialing exam. Training nonphysical therapists in MDT has demonstrated economic and health outcomes benefits in the private health sector, and we believe similar gains can be realized within the military health system.⁴⁴

Brigade and division levels. To achieve the pinnacle of quality assurance and control in MSKI management and its corresponding training programs, it is essential to elevate the training of H2F and/or brigade MSK providers to a level of mastery. In parallel to how



1st Lt. Benjamin McDaniels, a physical therapy intern, consults with a patient at the Soldiers in Training Physical Therapy Clinic at Fort Sam Houston, Texas, 17 May 2023. The Soldiers in Training Physical Therapy Clinic provides walk-in services as well as scheduled appointments. (Photo by Jason W. Edwards, Department of Defense)

an armored brigade combat team benefits from the expertise of a brigade master gunner, every brigade should similarly have a designated master MSK clinician to ensure the highest standards of musculoskeletal care and proficiency. At echelons above brigade, parallel structures should be organized within the division and corps surgeon cells. In units executing reconstitution, the master MSK clinician in the higher echelon fills a critical role in RTD forecasting for soldiers recovering from MSKI.

It bears repeating that accurate prognosis and staff communication during reconstitution is impossible without a common operating picture. Similar to a master gunner's training, each master MSK clinician should learn the same language, procedures, and protocols. As of yet, no program accomplishes this, complicating the continuity of care. The language of MDT provides this—trained clinicians can classify MSKI, and each classification communicates the nature of

the problem and the duration of recovery. Mastery of MDT is accomplished through the MDT diploma program. Diploma candidates must already possess MDT certification. This diploma program includes a semester of online schoolwork, a nine-week clinical residency, and a final oral board exam.

MDT is considered a postgraduate program and is outside the scope of entry-level medical training. We recommend gaining units fund this training for inbound personnel in lieu of changes to professional military education. Physical therapists serving as the master MSK clinicians may demonstrate additional proficiency through board certification in either orthopedic or sports physical therapy. If the position is held by another health-care provider, we would suggest an orthopedic surgeon, fellowship-trained orthopedic physician assistant, or sports medicine physician. In all cases, a diploma in MDT forms the common denominator in MSK training.

Quality Assurance and Quality Control

At brigade level and above, tracking and actioning on relevant measures of performance and measures of effectiveness are essential to implementation. Measures of performance may include the number of personnel trained, to what degree they are trained, and the frequency of retraining for combat medics. Measures of effectiveness may include specialty care visits for MSKI, duty days lost due to MSKI (temporary profile), and a number of medical evaluation boards initiated for MSKI.

Master clinicians will evaluate their certified colleagues through the above in concert with patient survey items. These surveys track a soldier's self-rated readiness to deploy, confidence in passing the Army Combat Fitness Test, level of pain, and level of pain-related disability. The Military Orthopedics Tracking Injuries and Outcomes Network (MOTION) is the designated Defense Health Agency database for collecting, securing, and analyzing this information. Using MOTION outcomes, master clinicians can conduct azimuth checks on individual courses of recovery and provide "in-flight" corrections to maximize RTD. This process is known as MOTION/MSK triage, and it is a current Defense Health Agency initiative. Using MOTION is not yet a widespread practice in H2F, though this must change if we are to holistically understand care outcomes.

An Investment That Puts People First

It takes an estimated \$40,000–\$70,000 to produce a soldier.⁴⁵ A soldier who suffers an MSKI within their first term of service and is medically discharged incurs additional costs—both in terms of money and opportunity. From 2011 to 2016, MSKIs factored into 91 percent of the medical separations for first-term enlistees. Even beyond the first term of service, the loss of a soldier compromises small-unit training and prolonged temporary profiles that culminate in the medical evaluation board process delay the arrival of replacements. This is particularly acute in low-density specialties. Monetarily, the Army has lost the initial cost of training the soldier, the wages paid while the soldier was recovering, and whatever amount of severance pay the soldier is entitled to.

Following discharge, the soldier may then be eligible for VA compensation for a service-connected disability. Notably, the annual expenditure for this compensation has surged, now exceeding \$70 billion annually.⁴⁶ Considering these costs, investing \$3,600 for each MDT-certified clinician and \$20,000 for every MDT diplomat emerges as an exceptionally prudent and financially sound decision. Recently, the Army allocated \$100 million toward an advanced human performance wearable technology program, complemented by further investment in CoachMePlus exercise planning software.⁴⁷ While these wearables show potential in injury prediction, their current reliability (consistency of measurements) and validity (accuracy in measuring what they claim) vary.⁴⁸ In contrast, clinicians trained in mechanical diagnosis and therapy (MDT) consistently exhibit high reliability in assessments, accurately predicting patient recovery timelines and outcomes.⁴⁹ Furthermore, health systems and individual practices employing MDT-trained clinicians have demonstrated superior clinical and economic results.⁵⁰ Considering these factors, the investment in MDT training presents a significantly greater value for a lower cost.

Conclusion

The Army's implementation of the H2F program represents a strategic initiative to effectively address the widespread issue of MSKI. However, there's a noticeable gap in translating the successes of tactical combat casualty care to musculoskeletal care. Effective MSKI management, akin to combat casualty care, requires a seamless integration of standardized practices across medical capabilities. MDT provides this integration, offering a comprehensive framework that empowers soldiers, medics, and medical providers to conduct prompt and effective triage, assessment, treatment, and management of MSKI. The expanding evidence base consistently affirms the efficacy of MDT.⁵¹ It's imperative now for commanders to recognize the necessity of this training, not only as a measure of sustainment but as a critical aspect of reconstitution. Equally crucial is the need for policymakers and leaders of major commands to recognize and address the significant risk that MSKI poses to ensure long-term readiness and operational capability. ■

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or reference to, any commercial products or services does not constitute Department of Defense endorsement of those products or services.

Notes

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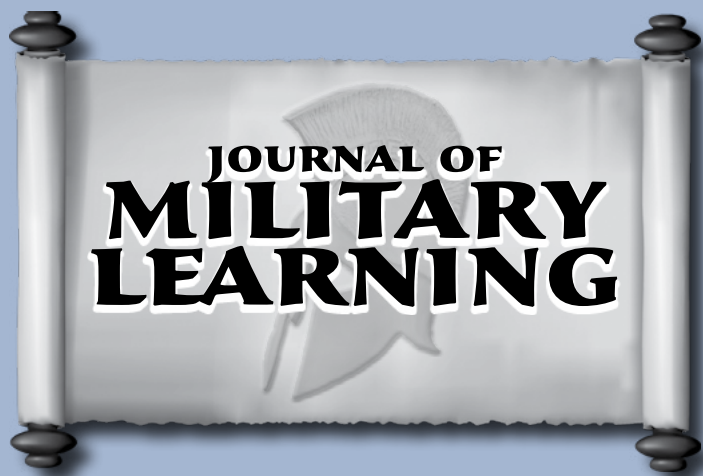
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