MHSRS 2026

# Developing Novel Solutions to Prevent & Treat Wound Infections on the Front Line

## Reducing Battlefield Infections in Prolonged Field Care: Equipping Soldiers with Antibiotic Autoinjectors

Abstract Title: "Enhancing Combat Healthcare: The Paradigm Shift to Intramuscular Antibiotic Delivery”

Monday 1415_MHSRS-26-6004

Dr. Sean Hollonbeck MD, MPH, MMAS

Colonel (retired) U.S. Army

# Disclosures

- I am an independent retired military physician. Previously worked at USAARL/MRMD and chaired a JPC.
- I own no stock.
- I have done consulting in the medical and legal industry.
- The opinions of this talk are mine and not those of the Department of War or DHA.
- 40 years of military and medicine service, experience.

# Immediate Battlefield Antibiotic Delivery at Point of Injury in LSCO, Preventing Prolonged Field Care Infections (in 15 minutes)

MHSRS 2026

•**The IV Challenge:** Traditional intravenous (IV) administration presents significant logistical and operational hurdles in austere environments, including:

- Weight and cube constraints
- Elevated hypothermia risks
- Intensive training and sustainment limitations

•**The Transformative Solution: Intramuscular (IM) Delivery**
IM antibiotic delivery using compact auto-injector devices is a transformative solution endorsed by **Tactical Combat Casualty Care (TCCC) guidelines**.

•**Rapid & Accurate Administration:** Auto-injectors allow field medics to administer medication quickly and precisely.

•**Logistical Relief:** Streamlines combat healthcare delivery and reduces the burden on medical teams.

**Strategic Imperative:**

•**Shifting Priorities:** General John M. Murray's strategic emphasis on transitioning from "**saving every life" to "saving the most lives"** highlights the critical role of antibiotics in combat care, especially amid intense operational scenarios.

•**Operational Readiness:** Immediate access to antibiotics through IM/IV dosing strictly meets TCCC recommendations and reflects the innovative DOW ethos.

•**Global Standard:** Simplifying protocols and enhancing operational readiness in the most austere environments.

# DVIDS story on the future of auto injectors

- The 59th Medical Wing's Chief Scientist's Office (Science & Technology-S&T), Air Force Special Operations Command (AFSOC), and AFMRA teamed up to advocate for the military use of this disruptive, life-saving technology.

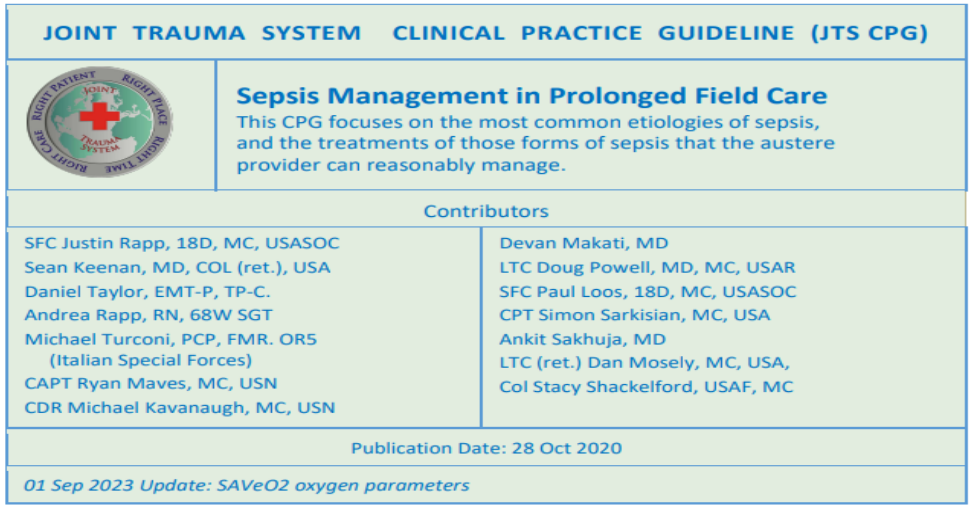
Photo By Tech. Sgt. Candin Muniz | A U.S. Air Force medical Airman provides simulated point of injury treatment

# DHA is funding auto injector work

MHSRS 2026

- Why the pivot to battlefield autoinjector antibiotics?
- What Sepsis really means to the war planners and the nation.
- Why auto injectors are simple, safe and cost effective for anyone, anytime, anywhere
- Drone delivery
- Resources are limited

- Joint Medical Planners
- Joint Military Leaders (training, safety, time)
- Joint Logistical Requirements



JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (JTS CPG)

**Sepsis Management in Prolonged Field Care**

This CPG focuses on the most common etiologies of sepsis, and the treatments of those forms of sepsis that the austere provider can reasonably manage.

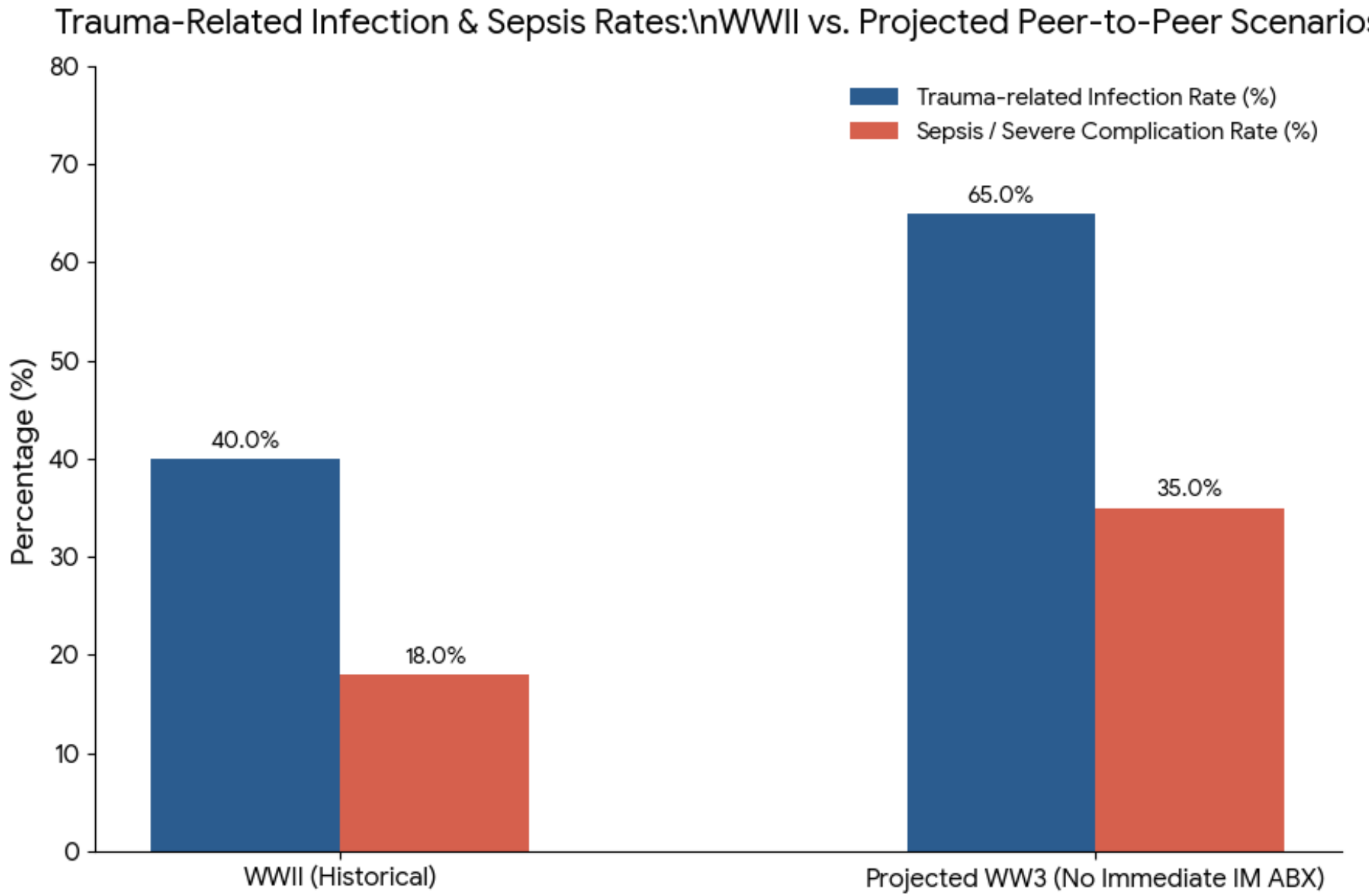
Contributors

SFC Justin Rapp, 18D, MC, USASOC
Sean Keenan, MD, COL (ret.), USA
Daniel Taylor, EMT-P, TP-C.
Andrea Rapp, RN, 68W SGT
Michael Turconi, PCP, FMR. OR5 (Italian Special Forces)
CAPT Ryan Maves, MC, USN
CDR Michael Kavanaugh, MC, USN
Devan Makati, MD
LTC Doug Powell, MD, MC, USAR
SFC Paul Loos, 18D, MC, USASOC
CPT Simon Sarkisian, MC, USA
Ankit Sakhuja, MD
LTC (ret.) Dan Mosely, MC, USA,
Col Stacy Shackelford, USAF, MC

Publication Date: 28 Oct 2020

*01 Sep 2023 Update: SAVeO2 oxygen parameters*

# Sepsis in LSCO 0.9% OEF/OIF vs  40% in WW3



# What does LSCO look like?

- **LSCO will generate up to 3,000 casualties per day** for a standard force of 100,000 deployed soldiers.

- **Large-Scale Warfighter Exercises:** Projections for full-scale operations estimate up to **50,000 total casualties** per major campaign phase, breaking down into approximately 10,000 killed, 30,000 requiring evacuation.

- **No Golden Hour, Day or Week.**

- PUBMED & Army University Press

- Partial Mobilization 2.5-4 Million troops
- Full Mobilization 15-30 Million

# Executive Summary: Infection Kills

MHSRS 2026

**Untreated Infection results in Sepsis**

- Sepsis Kills (0.9% OEF/OIF vs 40% LSCO)
- Sepsis ties up resources globally, costs money, time, manpower
- Preventing Sepsis is a long term quality of life issue

- Any providers in the room?
- Any providers that have done IVs in the snow and jungle?

**IV Challenges and Complications**

- IV medications have flow rate calculations deliver over varied times
- IV medications have to be reconstituted
- IV medications require a large and long logistical footprint
- Starting IV requires a lot of training, CLS ended over a decade ago
- Some IV medications if mixed with lactated ringers or blood products and cause harm
- IV medications require the IV to be the correct temperature
- IV fluids are heavy, very heavy and expire
- IV pumps are heavier, require power, power is heavy

# The Sepsis Cost: Prevention

- 970,000 cases per year
- “basic sepsis”
- $20-70,000 per case
- $28,000 first year follow up $
- Single complication repeats the admission cycle
- Amputations, end organ failure
- complications

Paoli  Epidemiology and Costs of Sepsis in the United States-An Analysis Based on Timing of Diagnosis and Severity Level. Crit Care Med. 2018

- Complex polytrauma battlefield injuries
- Global evacuation costs, fuel, equipment, manpower
- Cost of 1 heart attack in Iraq 07-09
- One amputation costs

Kurichi et al. Factors associated with total inpatient costs and length of stay during surgical hospitalization among veterans who underwent lower extremity amputation. Am J Phys Med Rehabil. 2013

# Start all trauma meds in under 7 minutes

MHSRS 2026

- **The Capability Gap:** Providing rapid, sterile, and broad-spectrum antibiotics within the "Golden Hour" in contested, austere, or prolonged field care environments. "Golden 7 minutes"

- **The TCCC Mandate:** Adherence to latest TCCC Guidelines protocols for combat wound infection control.

- **The Shift:** Moving from oral/IV protocols in chaotic environments to automated, miniaturized auto-injectors.
- "Anywhere, Anytime, Anyone"

# What are the top 3 things to save a life in LSCO combat?

MHSRS 2026

- Stop blood loss immediately
- TXA and tourniquets
- **Immediately start antibiotics**
- Irrigate and sterilize wounds in Prolonged Field Care


- Return fire, pin down, flank, kill the enemy – send the drone?

# CoTCCC the then Major Kevin O'Connor & CAPT Frank Bulter since 2002

MHSRS 2026

- Antibiotics are recommended for all open wounds in combat
- Immediate delivery
- Antibiotic Stewardship
- We will need input from stake holders - Funders, School Houses, major commands, SOCOM


**Antibiotics in Tactical Combat Casualty Care 2002**
MAJ Kevin O'Connor, MC USA; CAPT Frank Butler, MC USN
*Military Medicine. 168. 11:911. 2003*

MHSRS 2026 Abstract 1042 Session: Fighting the Invisible Enemy :
Combating Antibiotic Resistance in Combat Wounds

# Title: Immediate Battlefield Antibiotic Delivery at the Point of Injury, Preventing Prolonged Field Care Infections

Dr. Sean Hollonbeck MD, MPH, Colonel U.S. Army (retired) drhollonbeck@gmail.com 912-596-9660

**Introduction:**

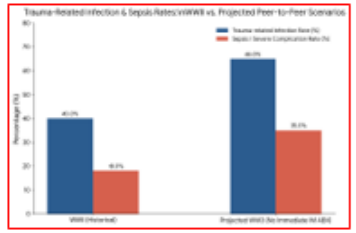
Combat healthcare faces a critical challenge: preventing infections during Prolonged Field Care (PFC). Preventing infection and sepsis remains a pivotal concern, with historical data revealing the persistent threat of infections leading to preventable casualties among military forces. Large Scale Combat Operations (LSCO) will result in massive disruption of medical logistics and trauma care in the 100,000s. Injured will not be cared for in the "Golden Hour" , day or even 72 hours or more. Infection and sepsis will be new global norm akin to 1800s warfare but often with less access to surgical interventions. The National Defense Authorization Act (NDAA), unclassified open source NDAA, OSD, DOW, DHA and themes the last seven years of MHSRS, SOMA, AUSA and Operational Medicine Conferences continue to prepare the nation and our medical system to get ready for LSCO.

**Discussion:**

Not addressing the historic delivery of battlefield antibiotics is akin to not focusing on drone warfare. We either rapidly advance or we will suffer immensely and unnecessarily. Medicine is the worst at edicts, protocols, mantras and self induced barriers when often obvious solutions exist. The medical protocol and science of shifting to tourniquets, freeze dried plasma, and TXA that took decades to embrace is tragic and cost lives. Rapid delivery of safe antibiotics is obvious to prevent infections, sepsis, suffering, death and complications. Antibiotics (ABX) come in three primary delivery forms, oral, IV and IM administration. IV ABX must be often times reconstituted, dosed and drawn up. Then an IV line must be started and those supplies must be on hand. Global conflict will destroy logistical lines and constrain evacuations. Casualties will not be in hospital settings for days or even weeks. IV fluids are bulky and the wrong IV fluid or cold IVs can kill., training stopped over a decade ago. A system to immediately safely start TCCC antibiotics anywhere, by anyone is needed.

TCCC oral medications have a role but compliance is always an issue. The most efficient solution for traumatic LSCO Point of Injury (POI) casualties is immediate self IM delivery. IM offers rapid, accurate medication administration, streamlining combat healthcare delivery and reducing logistical burdens for field medics and medical teams. This presentation explores the practical implications of IM ABX dosing, aligning with the evolving landscape of military operations. General John M. Murray's emphasis on transitioning from "saving every life" to "saving the most lives" underscores the critical role of ABX in combat care, especially amid intense LSCO scenarios. Immediate access to ABX through IM/IV dosing not only meets TCCC recommendations but also reflects the innovative ethos of the DOW. Advocacy for IM ABX underscores its potential as the global standard in trauma medicine, simplifying protocols and enhancing operational readiness in the most austere environments. In conclusion, the adoption of IM ABX delivery represents a pivotal advancement in combat healthcare, promising to mitigate infection-related casualties and optimize outcomes in challenging operational environments.

Sepsis Kills in LSCO
0.9% OEF/OIF vs 40% in LSCO



**LSCO will generate up to 3,000 casualties per day** for a standard force of 100,000 deployed soldiers.

**Large-Scale Warfighter Exercises:** Projections for full-scale operations estimate up to **50,000 total casualties** per major campaign phase, breaking down into approximately 10,000 killed, 30,000 requiring evacuation.

**No Golden Hour, Day or Week.**

PUBMED & Army University Press

Methods:
Using open source
NDAA, OSD, DOW, study of WW1, WW2, current conflicts PACOM and AI predictions, Pub Med, attending DHA, MHSRS, SOMA, AUSA, SOF Week, Joint Medical Journals, Operational Medicine and 40 years of experience

**Results:**

Advocacy for the paradigm shift to IM Antibiotics is being driven by the DHA and military medicine. The shift underscores the speed, safety and reduced training and logistical burdens as the new global standard in trauma medicine. This simplifies protocols and enhances operational readiness in the most austere environments and frankly in dual use civilian settings. No dosing errors, no IV complications. The adoption of IM antibiotic delivery represents a pivotal advancement in combat healthcare, promising to mitigate infection-related casualties and optimize outcomes in challenging operational environments.

Four decades of study, real world military medicine, hospital systems, MASCALS, disaster zones, and research lead this author to clear conclusions. The delivery of battlefield antibiotics should be immediate, dose controlled drone ready and universal available. Delivery should be immediate by anyone, anytime anywhere.

**Enhancing Combat Healthcare: The Paradigm Shift to Intramuscular Antibiotic Delivery**

**Conclusions**

Infection and sepsis during LSCO will reach staggering rates never seen in modern war. The NDAA and open source intelligence are clear. The TCCC guidelines are clear. If conflict occurs we must be ready and we must be able to pivot rapidly and think in global medical and logistical (supplies, cost, training, access) mindset saving the most lives. Drone delivery and simplicity are a must. Modern autoinjectors are often one step systems.

As rapidly as possible from POI antibiotics need to be started on casualties to prevent and slow infections in complex and even simple battlefield wounds. Oral, IV and IM delivery can offer rapid, accurate medication administration, however IV delivery is not sustainable from a logistics and training footprint. In appropriate walking wounded cases oral delivery is ideal. In the rest of the penetrating, severely injured cases a simplified approach is mandated. Streamlining combat healthcare delivery and reducing logistical burdens for field medics and medical teams is a much of a decision point as antibiotic resistances. Septic patients require extraordinary resources in regular healthcare. One thing is certain, in LSCO and PFC delays in TCCC antibiotics will result in hundreds of thousands of preventable infections and deaths with massive demands on deployed and stateside healthcare teams.

This poster explores the practical implications of immediate IM antibiotic dosing, aligning with the evolving landscape of military operations. General John M. Murray's emphasis on transitioning from "saving every life" to "saving the most lives" underscores the critical role of antibiotics in combat care, especially amid intense operational scenarios. Immediate access to antibiotics through IM/IV dosing not only meets TCCC recommendations but also reflects the logistical and safety demands of global LSCO of military and civilian casualties with massive delays in traditional healthcare standards.

# LSCO 40-55% Casualty Rate
# “DOW” Died of Wounds

An Army Ranger combat medic conducts routine medical training during 2nd Battalion, 75th Ranger Regiment, task force training in August 2019. The Ranger O Low Titer (ROLO) Whole Blood Program protocol, designed to bring emergency blood transfusion from the hospital to the battlefield, is practiced multiple times a year with volunteers and medics to maintain a high level of medical proficiency. (Photo by Sgt. Jaerett Engeseth, U.S. Army)

DVIDS photo

# References:


•BMJ Mil Health 2020 Jun;166(3):175-178.
doi: 10.1136/jramc-2018-001033. Epub 2018 Dec 7.
For debate: on-the-person battlefield antibiotics Edward Rogers

- JTS Sepsis Management in Prolonged Field Care 2023
- Journal of Clinical Medicine 2025 Sep 23;14(19):6691. doi: 10.3390/jcm14196691 The Burden of Sepsis and Septic Shock in the Intensive Care Unit, Lugi et al.
- https://www.dvidshub.net/news/486651/teaming-with-small-business-improve-technology-save-lives-battlefield
- Paoli CJ, Reynolds MA, Sinha M, Gitlin M, Crouser E. Epidemiology and Costs of Sepsis in the United States-An Analysis Based on Timing of Diagnosis and Severity Level. Crit Care Med. 2018 Dec;46(12):1889-1897. doi: 10.1097/CCM.0000000000003342. PMID: 30048332; PMCID: PMC6250243.
- https://www.armyupress.army.mil/journals/military-review/online-exclusive/2025-ole/medicine-as-ammunition/#:~:text=Treating%20Medicine%20as%20Ammunition,Brig.%20Gen.%20Clinton%20K.
- **Antibiotics in Tactical Combat Casualty Care 2002.** MAJ Kevin O'Connor, MC USA; CAPT Frank Butler, MC USN, *Military Medicine. 168. 11:911. 2003*
- JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (JTS CPG)
- Paoli CJ, Reynolds MA, Sinha M, Gitlin M, Crouser E. Epidemiology and Costs of Sepsis in the United States-An Analysis Based on Timing of Diagnosis and Severity Level. Crit Care Med. 2018 Dec;46(12):1889-1897. doi: 10.1097/CCM.0000000000003342. PMID: 30048332; PMCID: PMC6250243.
- Kurichi JE, Vogel WB, Kwong PL, Xie D, Bates BE, Stineman MG. Factors associated with total inpatient costs and length of stay during surgical hospitalization among veterans who underwent lower extremity amputation. Am J Phys Med Rehabil. 2013 Mar;92(3):203-14. doi: 10.1097/PHM.0b013e31827446eb. PMID: 23117271; PMCID: PMC3601547.

# LSCO Conclusion & Impact

The adoption of IM antibiotic delivery represents a pivotal advancement in combat healthcare. By simplifying dosing protocols and overcoming the limitations of IV lines, field medics can drastically reduce infection-related complications during extended care scenarios.

The overall reduced risks of infection and impact of sepsis saves resources and lives.