PREVENTING THE SECOND HIT:
FROM BENCH TO BATTLEFIELD IN THE FIGHT AGAINST INFECTION

Jennifer Gurney, MD FACS
COL, MC, US Army

Military Health System Research Symposium
2 August 2026

Disclosures

The following are the private views of the presenter and are not official policy and are not intended to represent the views of the Department of the Army, the Department of Defense, or the Defense Health Agency.

No conflicts of interest.

No financial disclosures.

The movement of battlefield medicine from *delayed, empiric, evacuation-dependent care toward earlier recognition*, biologically precise treatment, immune rescue, and tissue regeneration → these advances will matter only if we turn them into an *integrated, deployable, learning trauma capability*

Multi Drug Resistant Organisms

THREAT

Measure

Detect

Rapidly / Respond

Outpace

Measure what is happening in the wound

Detect infection prior to clinical manifestation

Rapidly / **R**espond prevent and treat

Outpace the evolution and pace of resistance

Measure what is happening in the wound

Detect infection prior to clinical manifestation

Rapidly / Respond prevent and treat

Outpace the evolution and pace of resistance

Strategy without tactics is the
slowest route to victory.
Tactics without strategy is the
noise before defeat

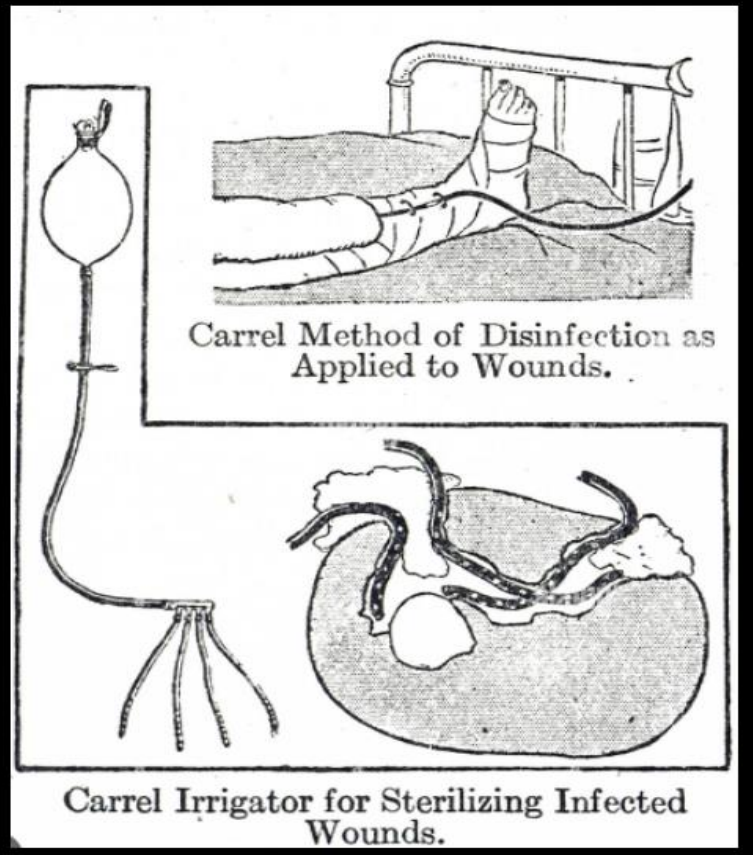
Sun Tzu

The Story of US Modern Day Wound Infection Detection

- Infection on the battlefield is as old as the battlefield

- **Dakin's Solution**
  - sodium hypochlorite wound asepsis
- **Carrel**
  - debridement & repeated irrigation

The **Carrel–Dakin method** combined source control, debridement & repeated delivery of antiseptic; ***the chemistry alone was not the entire capability***



Carrel Method of Disinfection as Applied to Wounds.

Carrel Irrigator for Sterilizing Infected Wounds.

The Joint Biological Agent Identification and Diagnostic System (JBAIDS) and Entomology

Major Jamie Blow
USAMRIID

Joint Biological Agent Identification and Diagnostic System (JBAIDS) ORD

During Operation Desert Storm, a major deficiency identified was the inability of U.S. forces to effectively defend against biological warfare (BW) and other biological agents of operational concern. Current national military strategy specifies a worldwide force-projection capability that requires identification, diagnosis, and vaccination to protect U.S. forces against potential biological threats. Reliance on traditional laboratory methods, located in rear or CONUS locations, did not provide timely information needed for force health protection. Thus, the need for this capability was identified resulting in the JBAIDS ORD.

The Joint Biological Agent Identification and Diagnostic System (JBAIDS) and Entomology

Major Jamie Blow
USAMRIID

Block I Agents

- Anthrax
- Brucella
- Ebola-Marburg
- Encephalitis
  - VEE/EEE/WEE
- Glanders
- Plague
- Q Fever
- Smallpox
- Tularemia
- Typhus
- Cholera
- CCHF
- Cryptosporidium
- Dengue fever
- *Escherichia coli*
- Hantaan
- Influenza
- RVF
- Salmonella
- Shigella

The Joint Biological Agent Identification and Diagnostic System (JBAIDS) and Entomology

Major Jam
US

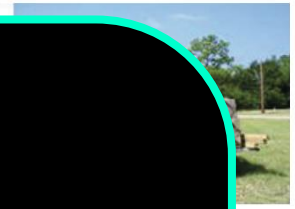
Blo

- Anthrax
- Brucella
- Ebola-Marburg
- Encephalitis
  - VEE/EEE/WEE
- Glanders
- Plague
- Q Fever
- Smallpox
- Tularemia
- Typhus

DOD PROGRAMS

Joint Biological Agent Identification and Diagnostic System (JBAIDS)

Executive Summary



nts

d

oard

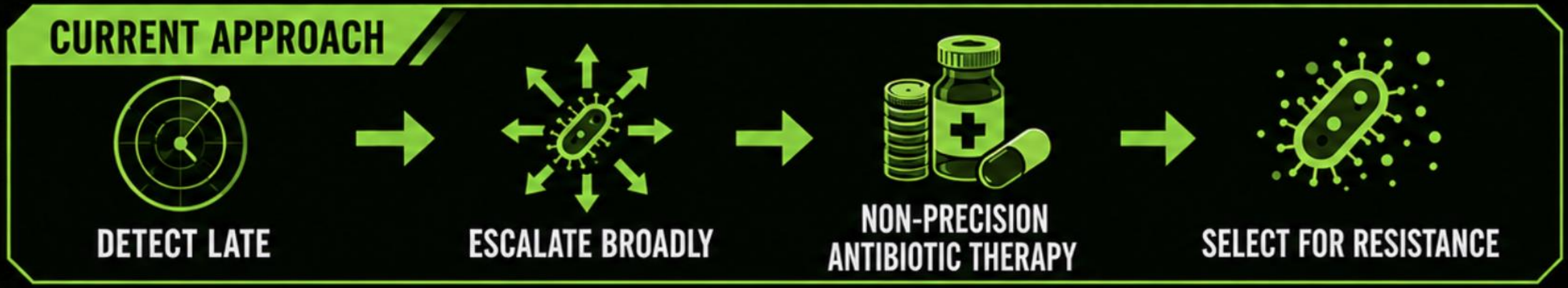
diagnostic tool.

uation Center,
ation Command and
Evaluation Activity,
conducted the IOT&E at Brooks City Base, Texas, during May 2005. Sixteen matrices were spiked with 10 inactivated biological warfare agents. The Commander, Operational Test and Evaluation Force conducted an operational evaluation on USS *Blue Ridge* in Western Pacific Operation Area during May and June 2005.

Klebsiella
Pseudomonas
Acinetobacter
Enterobacter

Klebsiella
Pseudomonas
Acinetobacter
Enterobacter

Smell should not be the best of our early diagnostic capability for the battlefield!



Three Takeaways

1) ***Recognize the threat*** **–** infection is the second hit & a threat to combat power

2) ***Change the timeline*** **–** detection must be rapid and operational….early enough to change biology

3) ***Change the strategy*** **–** a layered defense / approach; not antibiotic escalation alone

Recognize the threat – infection is the second hit & a threat to combat power

- Infection is the second hit…and it has a different operational signature
  - Develops silently
  - The clinical burden accumulates over days / weeks
- MDRO moves beyond the casualty
  - Through evacuation platforms, hospitals, partner nations, and into the civilian system

Recognize the threat – infection is the second hit & a threat to combat power

Three Things Improve Battlefield Survivability…from trauma

Speed

Prehospital Blood

Hemorrhage Control

Recognize the threat – infection is the second hit & a threat to combat power

MILITARY MEDICINE, 184, S2:18, 2019

After the Battlefield: Infectious Complications among Wounded Warriors in the Trauma Infectious Disease Outcomes Study

David R. Tribble, MD, DrPH; COL Clinton K. Murray, USA, MC†††; Col Bradley A. Lloyd, USAF, MC‡‡‡; Anuradha Ganesan, MBBS, MPH*§ ‖; Katrin Mende, PhD*† ‖; Maj Dana M. Blyth, USAF, MC†; MAJ Joseph L. Petfield, USA, MC‡; Jay McDonald, MD¶***

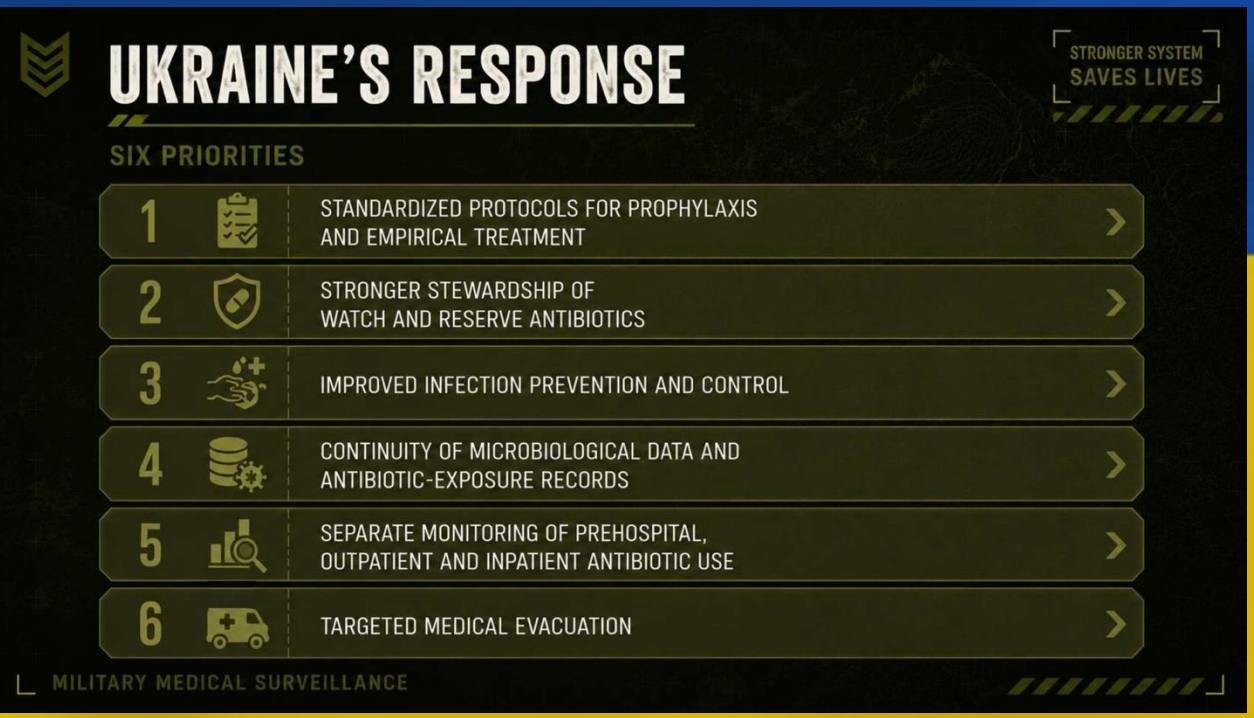
In the Trauma Infectious Disease Outcomes Study:

- ~ 34% of 2,699 transferred combat casualties developed a trauma-related infection during their initial hospitalization
- 1/3 developed another trauma-related infection after discharge
- 38% developed a new infection 88 days after discharge

Trauma	Infection

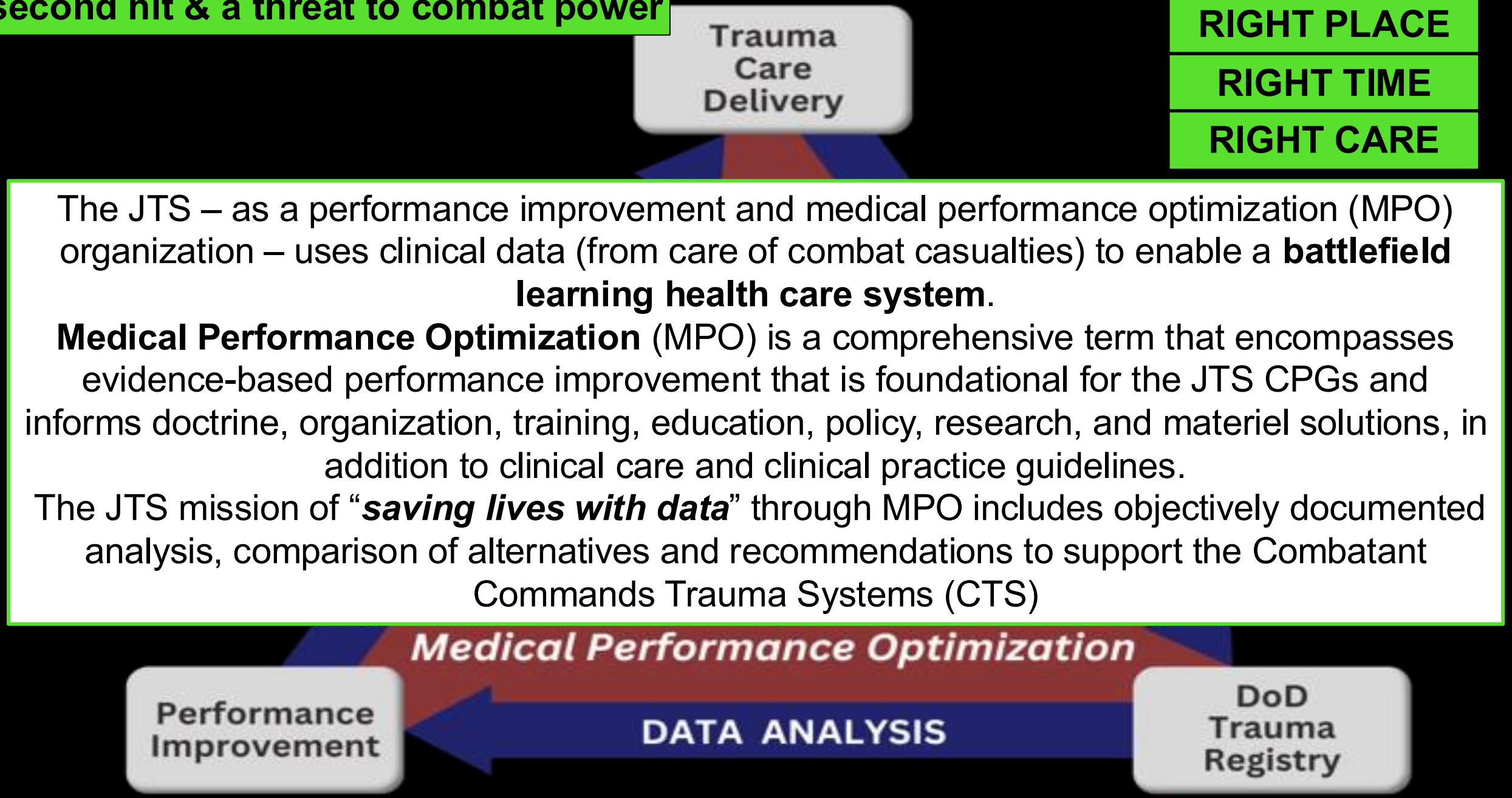
Recognize the threat – infection is the second hit & a threat to combat power

Our Ukrainian colleagues have shown us the modern version of the requirement



Recognize the threat **– infection is the second hit & a threat to combat power**

RIGHT PATIENT
RIGHT PLACE
RIGHT TIME
RIGHT CARE

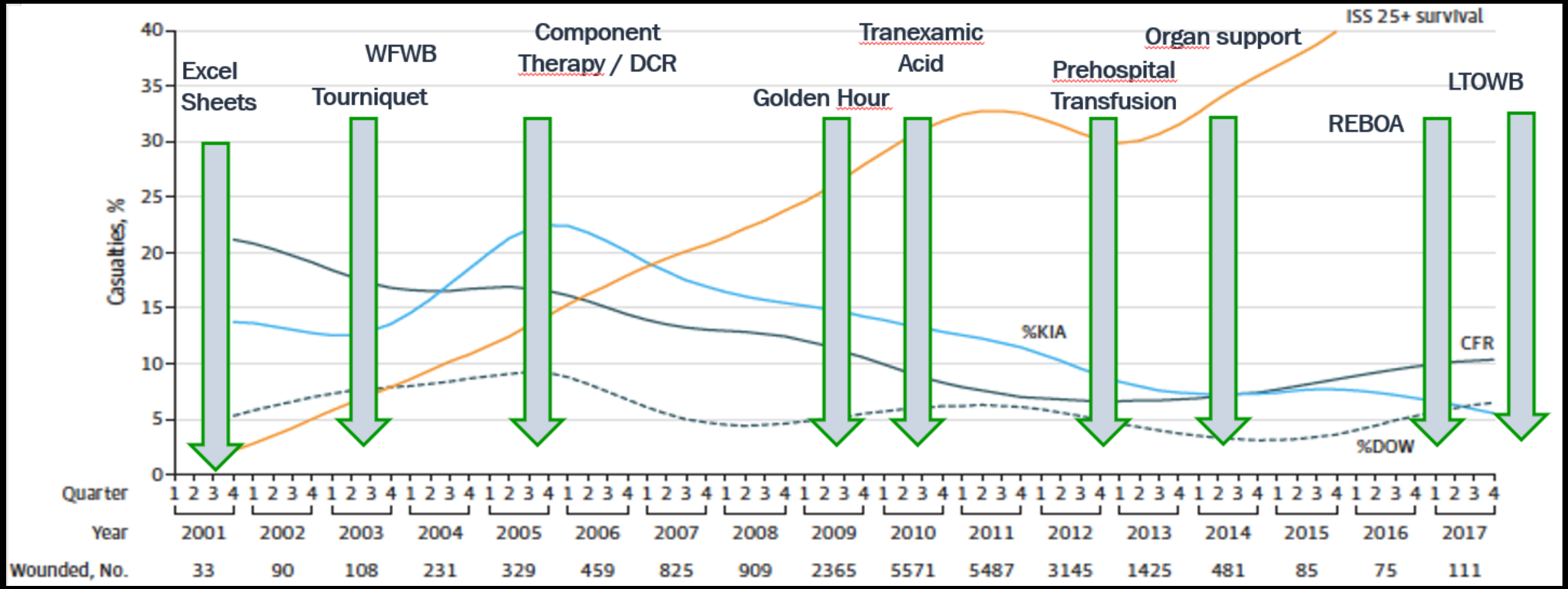


The JTS – as a performance improvement and medical performance optimization (MPO) organization – uses clinical data (from care of combat casualties) to enable a **battlefield learning health care system**.

Medical Performance Optimization (MPO) is a comprehensive term that encompasses evidence-based performance improvement that is foundational for the JTS CPGs and informs doctrine, organization, training, education, policy, research, and materiel solutions, in addition to clinical care and clinical practice guidelines.

The JTS mission of "***saving lives with data***" through MPO includes objectively documented analysis, comparison of alternatives and recommendations to support the Combatant Commands Trauma Systems (CTS)

Demonstrated Medical Performance Optimization



Three Takeaways

1) ***Recognize the threat*** **–** infection is the second hit & a threat to combat power

2) ***Change the timeline*** **–** detection must be rapid and operational….early enough to change biology

3) ***Change the strategy*** **–** a layered defense / approach; not antibiotic escalation alone

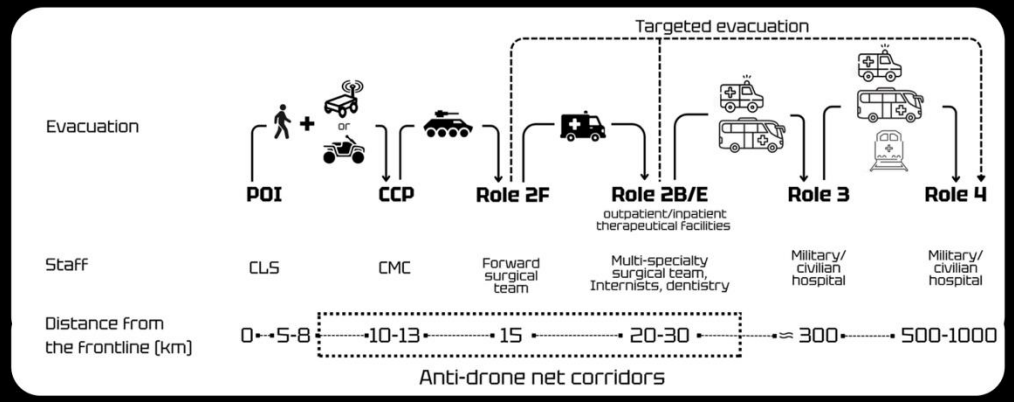
Change the timeline **–** detection must be rapid and operational….early enough to change biology

Point of injury

- Unavailability of a combat medic and predominantly self-care
- Complicated treatment in a drone kill zone
- Lack of water and dressings
- Drone delivery is not a universal solution
- The pill pack is often the only available option

Current evacuation chain & chellenges

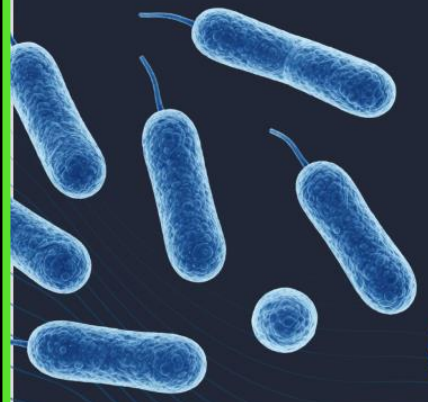
- Average evacuation time from the front line to Role 2F is 6-10 hours for unstable and 20 hours for stable casualties.
- The most critical stage is the evacuation from POI to CCP.



Change the timeline – detection must be rapid and operational….early enough to change biology

WAR & INFECTIONS: UNAVOIDABLE DESTINY OR AN INTERRUPTIBLE CHAIN?

INNOVATING ACROSS THE CONTAMINATION-TO-INFECTION CASCADE IN UKRAINE'S PROLONGED TRAUMA EVACUATION PATHWAY



Hailie Uren
Chief Specialist of Antimicrobial Resistance and Infection Control
Public Health Center of the Ministry of Health of Ukraine
h.uren@phc

PUBLIC

SURVEILLANCE IS IMPORTANT,

YET WITHOUT INTERVENTIONS TO IMPROVE CASUALTY OUTCOMES, WHAT'S THE POINT?

Change the timeline – detection must be rapid and operational….early enough to change biology

Measure what is happening in the wound

Detect infection prior to clinical manifestation

Rapidly / Respond prevent and treat

Outpace the evolution and pace of resistance

SURVEILLANCE IS IMPORTANT,

YET WITHOUT INTERVENTIONS TO IMPROVE CASUALTY OUTCOMES, WHAT'S THE POINT?

Change the timeline – detection must be rapid and operational….early enough to change biology

Develop diagnostics to answer:

1) Is an infection developing?
2) What is causing it?
3) What will treat it?
4) What should the provider do starting at POI?

Rapidly / **R**espond **prevent and treat**

Outpace **the evolution and pace of resistance**

SURVEILLANCE IS IMPORTANT,

YET WITHOUT INTERVENTIONS TO IMPROVE CASUALTY OUTCOMES, WHAT'S THE POINT?

Multi Drug Resistant Organisms

THREAT

Change the timeline – detection must be rapid and operational….early enough to change biology

TACTICAL

MEDICAL

THREATS

TACTICAL

MEDICAL

Multi Drug Resistant Organisms

TACTICAL

MEDICAL

Make Detection Rapid Operational

Change the timeline – detection must be rapid and operational….early enough to change biology

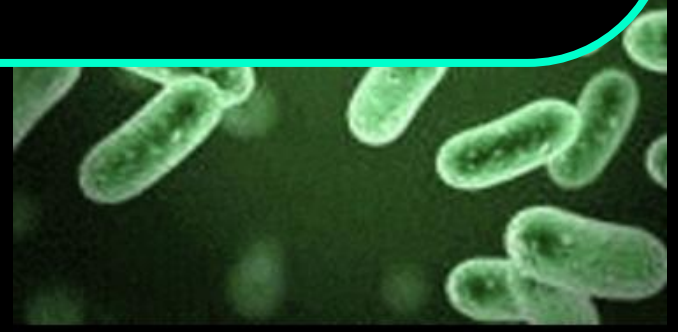
Drone warfare	Battlefield infection

Change the timeline – detection must be rapid and operational….early enough to change biology

TACTICAL MEDICAL

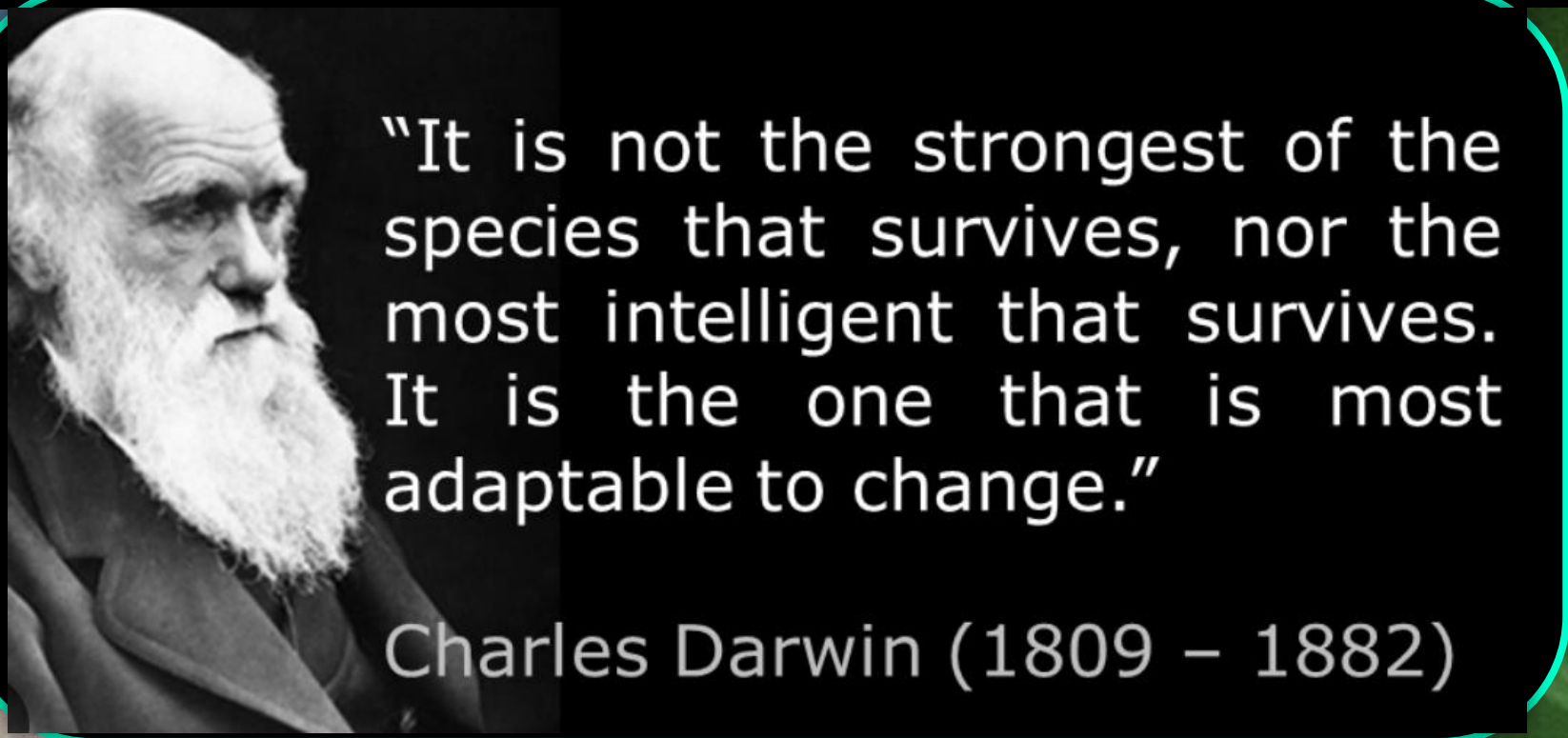
Research Questions:

1) Could every dressing change be a diagnostic event?
2) Could a dressing detect increasing bacterial burden, changing pH, falling tissue oxygenation bacterial metabolites, or a changing host response?
3) Can we develop tools to recognize the difference between colonization and infection?



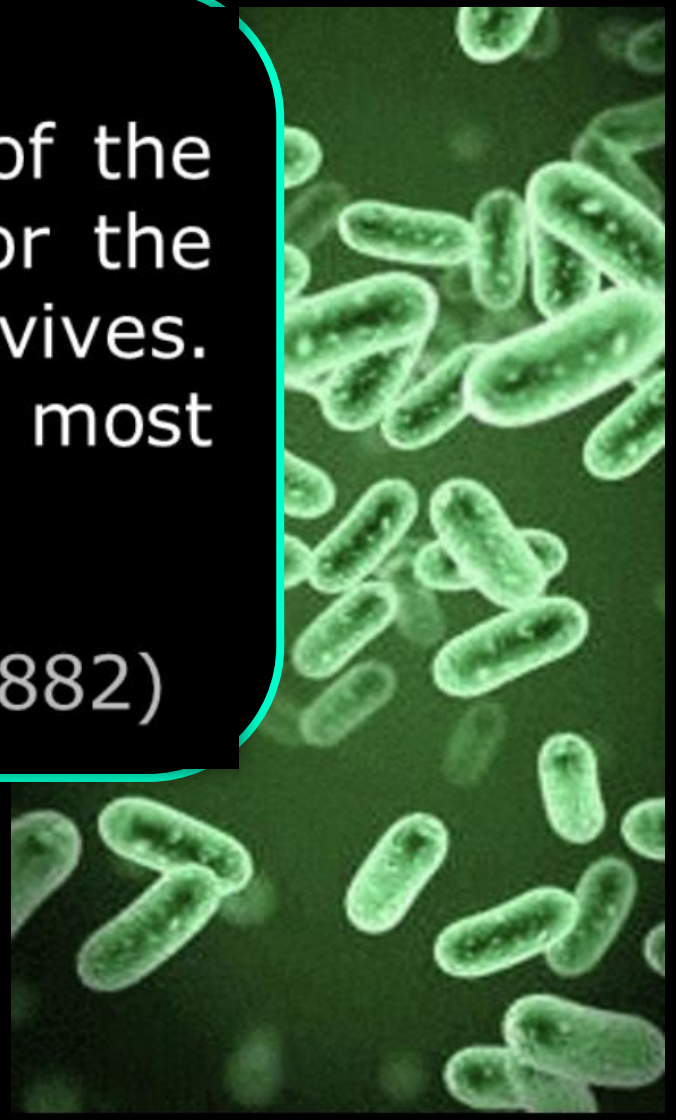
TACTICAL

MEDICAL



"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change."

Charles Darwin (1809 – 1882)



"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change."

MEDICAL

TACTICAL

THREATS

Three Takeaways

1) ***Recognize the threat*** **–** infection is the second hit & a threat to combat power

2) ***Change the timeline*** **–** detection must be rapid and operational….early enough to change biology

3) ***Change the strategy*** **–** a layered defense / approach; not antibiotic escalation alone

Change the strategy – a layered defense / approach; not antibiotic escalation alone

- For more than a century, the dominant strategy has been to respond to bacteria with increasingly sophisticated and broader antimicrobial weapons
- Early antibiotics and debridement at surgical capability remain essential -- but they cannot be the entire strategy

) ***Change the strategy*** – a layered defense / approach; not antibiotic escalation alone

Have we built a Patriot missile strategy for a drone-swarm problem?

Change the strategy – a layered defense / approach; not antibiotic escalation alone

- Patriot Missiles → Precision
- Artillery → Mass
- **Drones → Precision & Mass**

Have we built a Patriot missile strategy for a drone-swarm problem?

Strategy without tactics is the slowest route to victory.
Tactics without strategy is the noise before defeat

Sun Tzu

- MDROs present the same strategic challenge medically.
- Antibiotic resistance mechanisms can be remarkably precise, while the bacteria replicates at biological scale.
- Biofilm, polymicrobial communities & plasmids further increase that advantage.

Are Antibiotics Our Patriot Missiles?

Air and missile defense	Battlefield infection
Cheap drones made at scale	Bacteria replicate at scale
Swarms can saturate defenses	Biofilm & polymicrobial MDRO overwhelm wounds
Patriot provides exquisite interception	Advanced antibiotics provide exquisite treatment
Interceptors are finite	Antimicrobial options are finite
Winning each engagement may be unsustainable	Treating each infection broadly accelerates future resistance
Requires layered air defense	Requires layered biologic defense

Change the strategy – a layered defense / approach; not antibiotic escalation alone

TCCC 2025 Antibiotic Update

Antibiotics in Tactical Combat Casualty Care 2025

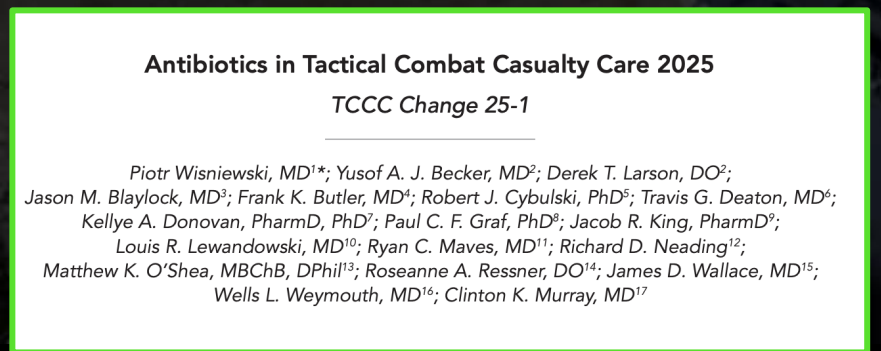
TCCC Change 25-1

Piotr Wisniewski, MD[1]; Yusof A. J. Becker, MD[2]; Derek T. Larson, DO[2]; Jason M. Blaylock, MD[3]; Frank K. Butler, MD[4]; Robert J. Cybulski, PhD[5]; Travis G. Deaton, MD[6]; Kellye A. Donovan, PharmD, PhD[7]; Paul C. F. Graf, PhD[8]; Jacob R. King, PharmD[9]; Louis R. Lewandowski, MD[10]; Ryan C. Maves, MD[11]; Richard D. Neading[12]; Matthew K. O'Shea, MBChB, DPhil[13]; Roseanne A. Ressner, DO[14]; James D. Wallace, MD[15]; Wells L. Weymouth, MD[16]; Clinton K. Murray, MD[17]*

Change the strategy – a layered defense / approach; not antibiotic escalation alone

TCCC 2025 Antibiotic Update

- TCCC 2025 update → an overall move toward a narrower & more stewardship-conscious prophylaxis
  - Reaffirmed early antibiotic administration, recommended prophylaxis for invasive procedures in the TCCC environment, found insufficient evidence to recommend topical antibiotics, and changed:
    - Oral moxifloxacin to **cefadroxil**, or **cephalexin** as alternative
    - Parenteral ertapenem to **ceftriaxone**



Antibiotics in Tactical Combat Casualty Care 2025

TCCC Change 25-1

Piotr Wisniewski, MD[1]; Yusof A. J. Becker, MD[2]; Derek T. Larson, DO[2]; Jason M. Blaylock, MD[3]; Frank K. Butler, MD[4]; Robert J. Cybulski, PhD[5]; Travis G. Deaton, MD[6]; Kellye A. Donovan, PharmD, PhD[7]; Paul C. F. Graf, PhD[8]; Jacob R. King, PharmD[9]; Louis R. Lewandowski, MD[10]; Ryan C. Maves, MD[11]; Richard D. Neading[12]; Matthew K. O'Shea, MBChB, DPhil[13]; Roseanne A. Ressner, DO[14]; James D. Wallace, MD[15]; Wells L. Weymouth, MD[16]; Clinton K. Murray, MD[17]*

Change the strategy – a layered defense / approach; not antibiotic escalation alone

Should we stop thinking about killing bacteria?

The DoW and the Evolution of Cell Therapeutics for Trauma

From Radiation Countermeasures to Regenerative Medicine for Warfighters

Shibani Pati, MD, PhD
Professor, Laboratory Medicine and Surgery
Director Center for Research in Transfusion Medicine and Cell Therapies
Girish N. Vyas Distinguished Professor and Endowed Chair University of California San Francisco

Cellular Therapies in Trauma and Critical Care State of the Science Meeting at Ft. Detrick in 2015

SHOCK, Vol. 44, No. 6, pp. 505–523, 2015

OPEN

Review Article

CELLULAR THERAPIES IN TRAUMA AND CRITICAL CARE MEDICINE: FORGING NEW FRONTIERS

Shibani Pati,*† Marcello Pilia,‡ Juanita M. Grimsley,‡ Alexia T. Karanikas,§ Blessing Oyeniyi,‖ John B. Holcomb,‖ Andrew P. Cap,¶ and Todd E. Rasmussen‡

*Blood Systems Research Institute, San Francisco, California; †University of California San Francisco, San Francisco, California; ‡Combat Casualty Care Research Program, Fort Detrick, Maryland; §Booz Allen Hamilton, Rockville, Maryland; ‖Department of Surgery, University of Texas, Houston, Texas; and ¶United States Army Institute of Surgical Research, Fort Sam Houston, Texas

The **2015 Department of War hosted a Cellular Therapies in Trauma and Critical Care Medicine meeting** at **Fort Detrick, Maryland.** It fundamentally changed how the military, academia, industry, regulators, and funding agencies viewed **cellular therapies as a legitimate platform technology for trauma.** The meeting was organized by the **Combat Casualty Care Research Program (CCCRP) under Director Col. Todd Rasmussen**

Change the strategy – a layered defense / approach; not antibiotic escalation alone

Should we stop thinking about killing bacteria?

What about <u>colonization resistance</u> or <u>microbiologic ecological control</u>?

Change the strategy – a layered defense / approach; not antibiotic escalation alone

A controllable live biotherapeutic or microbiome-derived wound therapy:

- A carefully selected commensal organism
- An engineered organism with a biological “kill switch”
- An organism deliberately susceptible to a rescue antibiotic

- **Leverage the microbiome**
- **Bring ‘healthy’ bacteria into a wound to out-compete the ‘bad bacteria’ → consume resources, produce bactericidins, and suppress the expansion and virulence of MDROs**

Change the strategy – a layered defense / approach; not antibiotic escalation alone


ARMY
We know what War Wounds look like

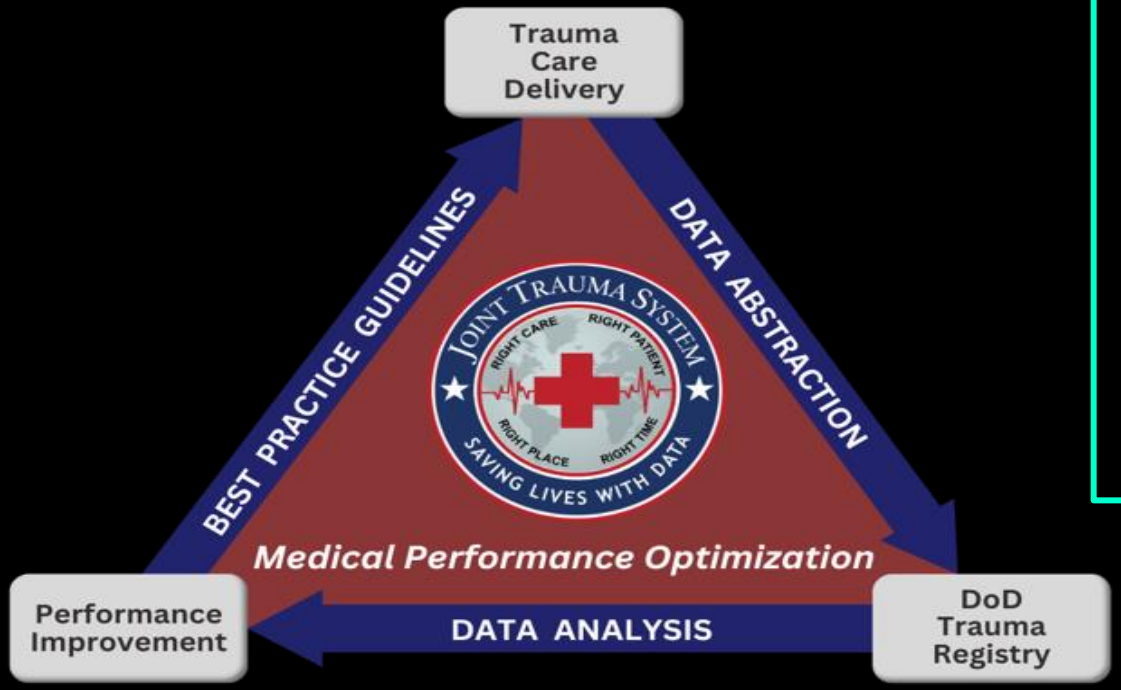
We know what War Wounds look like

We know what War Wounds look like

1) ***Recognize the threat –*** infection is the second hit & a threat to combat power

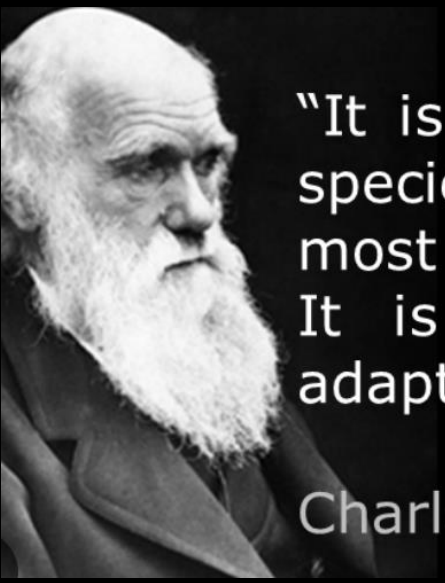
2) ***Change the timeline –*** detection must be rapid and operational….early enough to change biology

3) ***Change the strategy –*** a layered defense / approach; not antibiotic escalation alone



Multi
Drug
Resistant
Organisms

Measure
Detect
Rapidly / **R**espond
Outpace



"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change."

Charles Darwin (1809 – 1882)

Strategy without tactics is the slowest route to victory.
Tactics without strategy is the noise before defeat

Sun Tzu

The only mistake in life is the lesson not learned.

— Albert Einstein —

Thank you for helping us learn from your lessons

PREVENTING THE SECOND HIT:
FROM BENCH TO BATTLEFIELD IN THE FIGHT AGAINST INFECTION

Jennifer Gurney, MD FACS
COL, MC, US Army

Military Health System Research Symposium
2 August 2026

Are Antibiotics Our Patriot Missiles?

Air and missile defense	Battlefield infection
Cheap drones made at scale	Bacteria replicate at scale
Swarms can saturate defenses	Biofilm & polymicrobial MDRO overwhelm wounds
Patriot provides exquisite interception	Advanced antibiotics provide exquisite treatment
Interceptors are finite	Antimicrobial options are finite
Winning each engagement may be unsustainable	Treating each infection broadly accelerates future resistance
Requires layered air defense	Requires layered biologic defense

Change the strategy – a layered defense / approach; not antibiotic escalation alone

Dakin's Solution

- sodium hypochlorite wound asepsis

Carrel

- debridement & repeated irrigation

The **Carrel–Dakin method** combined source control, debridement & repeated delivery of antiseptic; ***the chemistry alone was not the entire capability***