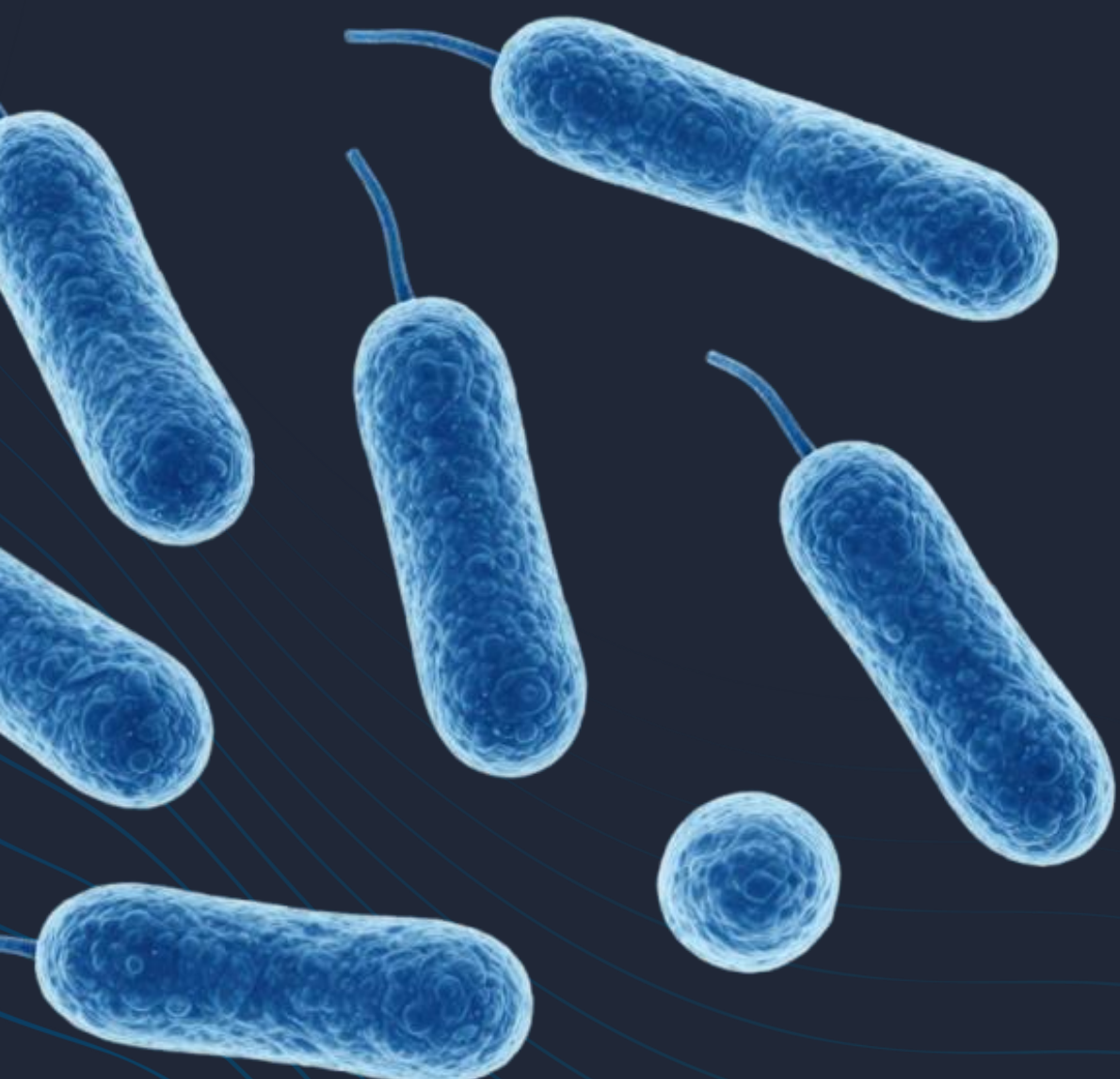


WAR & INFECTIONS: UNAVOIDABLE DESTINY OR AN INTERRUPTIBLE CHAIN?

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



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PUBLIC HEALTH CENTER



RAZOM
Together we are Ukraine



DISCLOSURES

GRANTS AND DONATIONS RECEIVED

- RAZOM FOR UKRAINE FOR SURVEILLANCE, INTERVENTION AND ASSESSMENT
- GRANT RECEIVED BY CANADA-UKRAINIAN FUND VIA MEDGLOBAL TO SUPPORT THE MICROBIOLOGY TEAM BIOCIDES PROJECT
- DONATION OF EQUIPMENT AND CONSUMABLES DONATED BY BIOMIQ™ NANOTESS™ COPAN™, ROCHE™ AND UVX INC™

PROFESSIONAL AFFILIATIONS:

- ADJUNCT LECTURER FOR GRIFFITH UNIVERSITY
- CHIEF SPECIALIST OF ANTIMICROBIAL RESISTANCE AND INFECTION CONTROL PUBLIC HEALTH CENTER OF THE MOH OF UKRAINE
- PAID CONSULTANT FOR RAZOM FOR UKRAINE FOR DURATION OF THE PROJECT

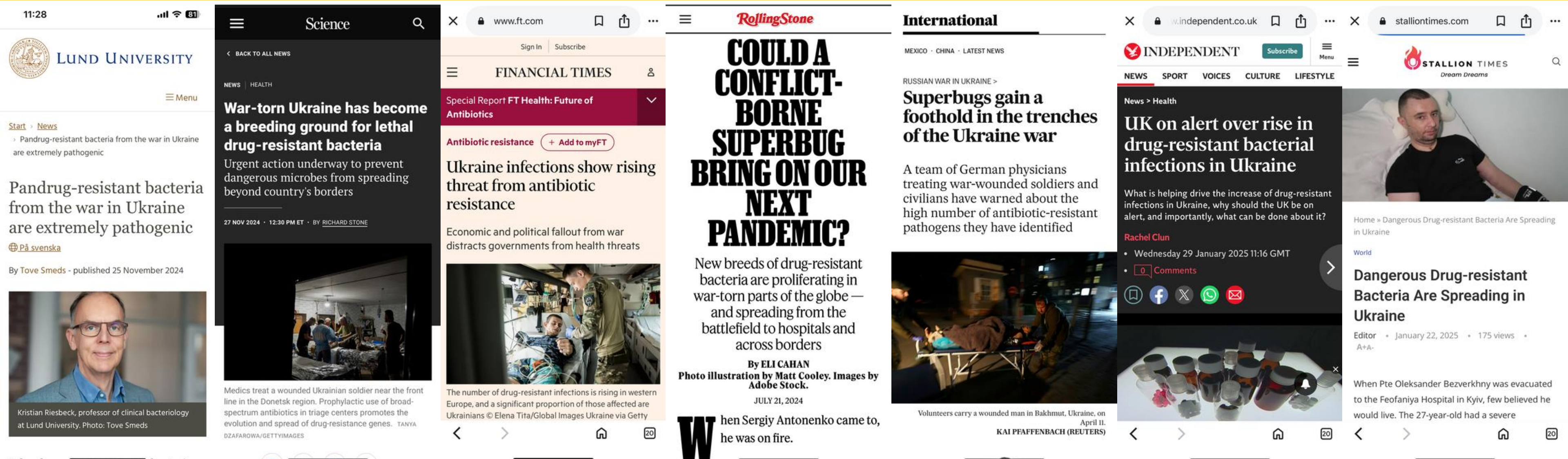
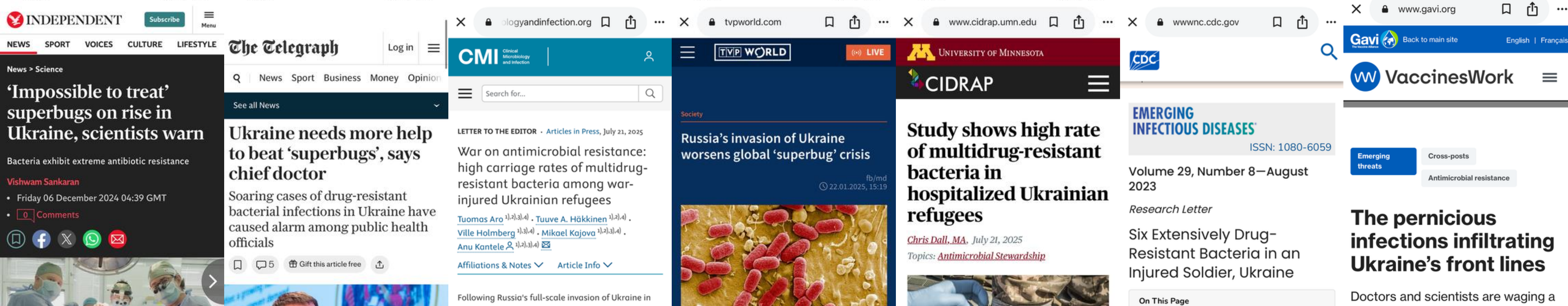


TO PUT IT INTO PERSPECTIVE

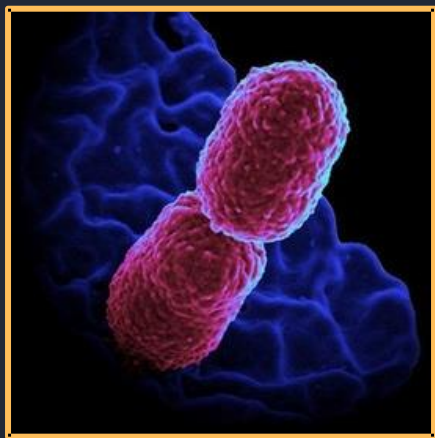
- Day 3: An 18-year-old with bilateral landmine blast injuries begins limb-salvage care for complex open fractures and extensive soft-tissue destruction.
- Days 3-20: Transferred through five facilities, undergoing approximately 30 awake debridement and irrigation procedures while awaiting definitive reconstructive capability.
- Day 25: Severe osteomyelitis infection with MDROs resistant to all available antibiotics leads to progressive necrosis of soft tissue and bone → bilateral non-salvageable limbs.
- Outcome: Bilateral above-knee amputations, lifelong prosthetic needs, and major consequences for rehabilitation and independence.

Designing a new combat casualty care model for the new war:

Interrupting the chain of contamination → colonisation → systemic infection → cross transmission requires system thinking, academically integrity research



WHAT WE KNOW IS AT THE END OF THE TRAUMA EVACUATION PATHWAY



K. pneumoniae

28%

Pan-resistant*



S. aureus

20%

MRSA



A. baumannii

37%

Pan-resistant*



P. aeruginosa

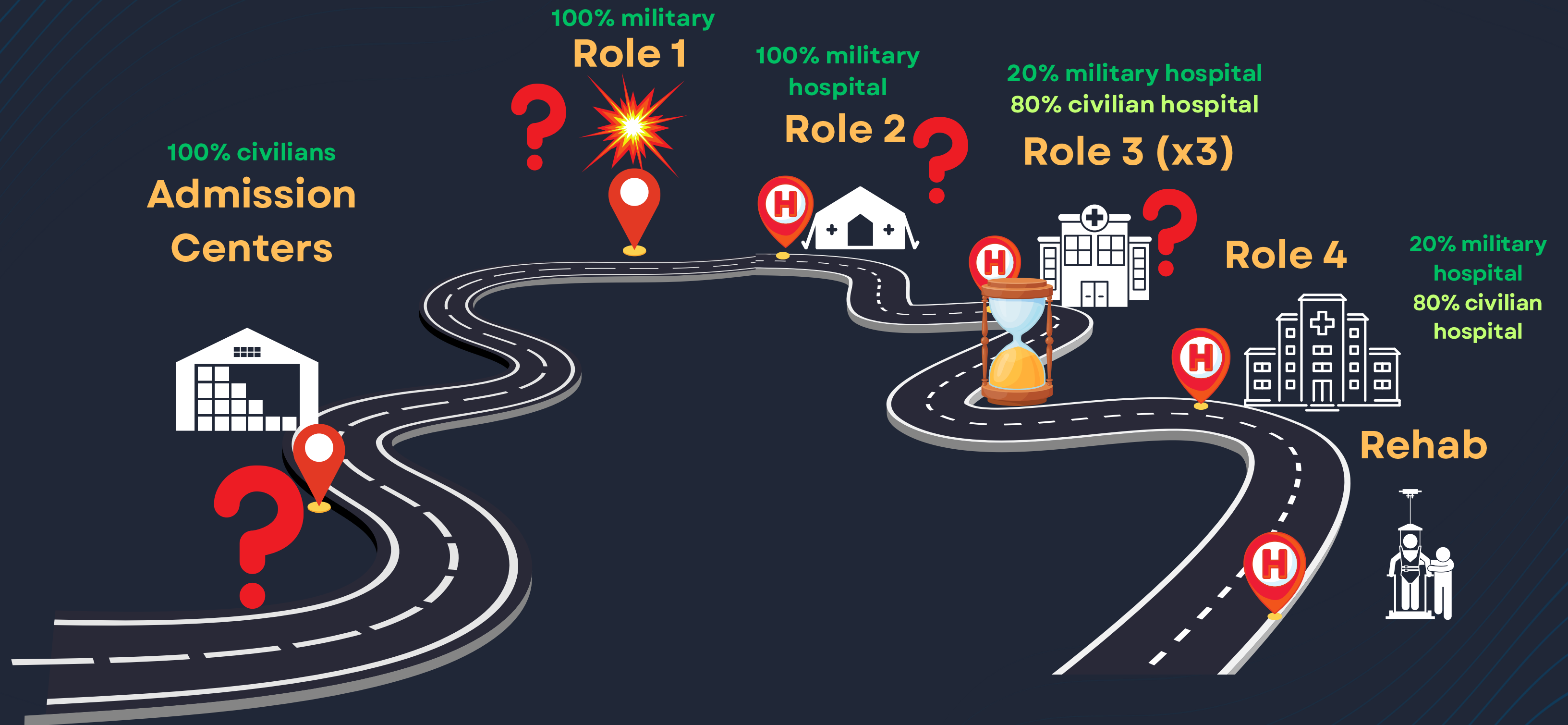
19%

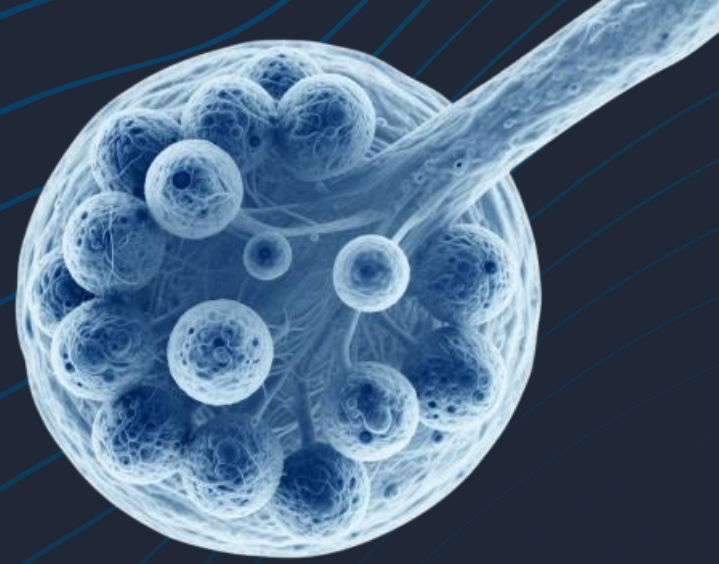
Pan-resistant*

Чутливість мікроорганізмів			
Найменування препаратів	Klebsiella pneumoniae 10^7	Acinetobacter spp. 10^3	Pseudomonas aeruginosa 10^5
Ампіцилін	***		
Амікацин	*C	*C	*C
Амоксицилін- клавунат	*C		
Азтреонам	*C		*C
Цефотаксим	*C		
Цефокситин	*C		
Ципрофлоксацин	*C	*C	*C
Левовфлоксацин	*C	*C	*C
Гентаміцин	*C	*C	
Тікарцилін-клавуланат	***		*C
Тобраміцин	*C	*C	*C
Триметопрім-Сульфаметоксазол	*C	*C	
Цефепім	*C		*C
Меропенем	*C	*C	*C
Імепенем	***	***	***
Піперацилін-тазобактам	*C	*C	*C
Цефтріаксон	*C		
Цефтазідім	*C		*C
Цефтазидин-авібактам	*C		*C
Цефтолазан-тазобактам	***	***	***
Пефлоксацин	***		
Цефтазидим		*C	***
Піперацилін			*C

*С - стійкий
*П – чутливий, збільшена експозиція
*Ч – чутливий

LOOKING AT EVERY LEVEL

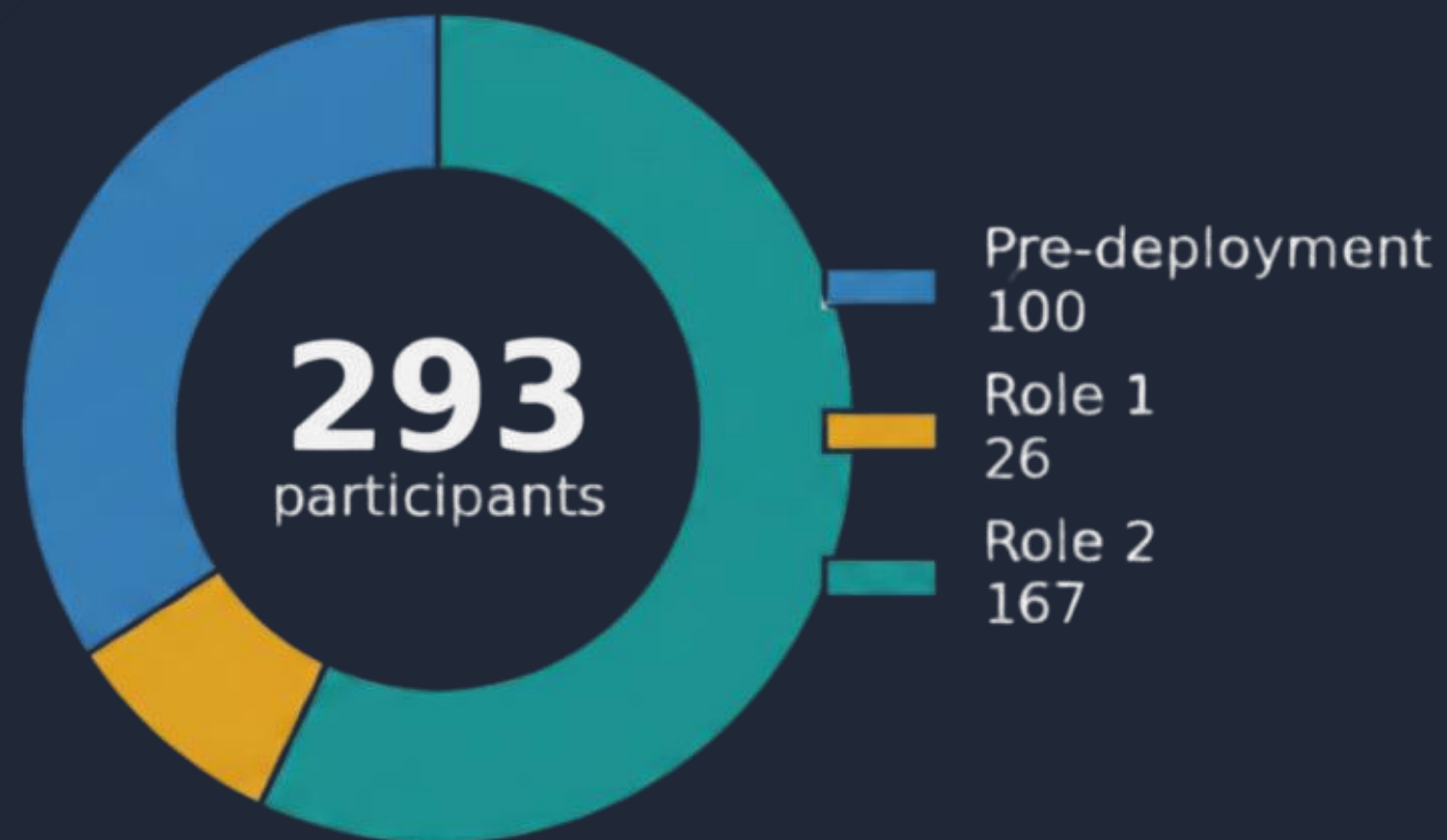




INTERIM FINDINGS

NOT YET STATISTICALLY SIGNIFICANT TO DRAW CONCLUSIONS

Current cohort composition

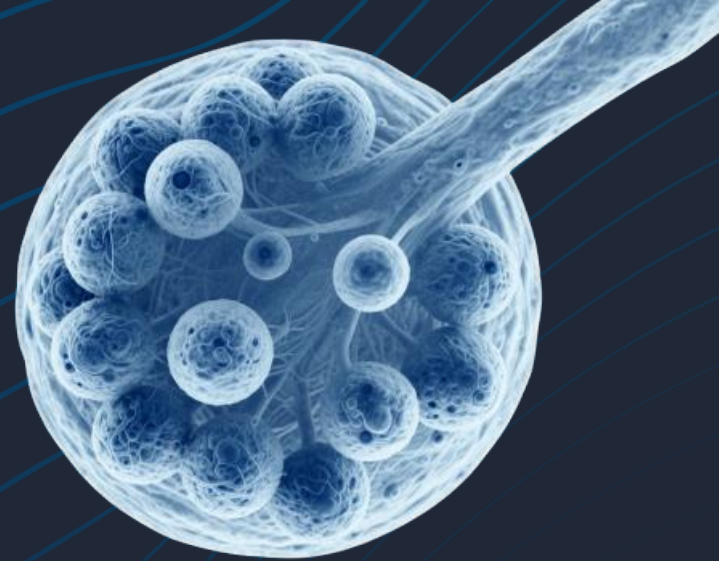


Average length of time from POI until sampling:

Role 1: Mean: 4.1 days (Range 1.3 to 288 hrs (12 days))

Role 2: Mean 3.1 days (Range 1 to 720 hours (30 days))

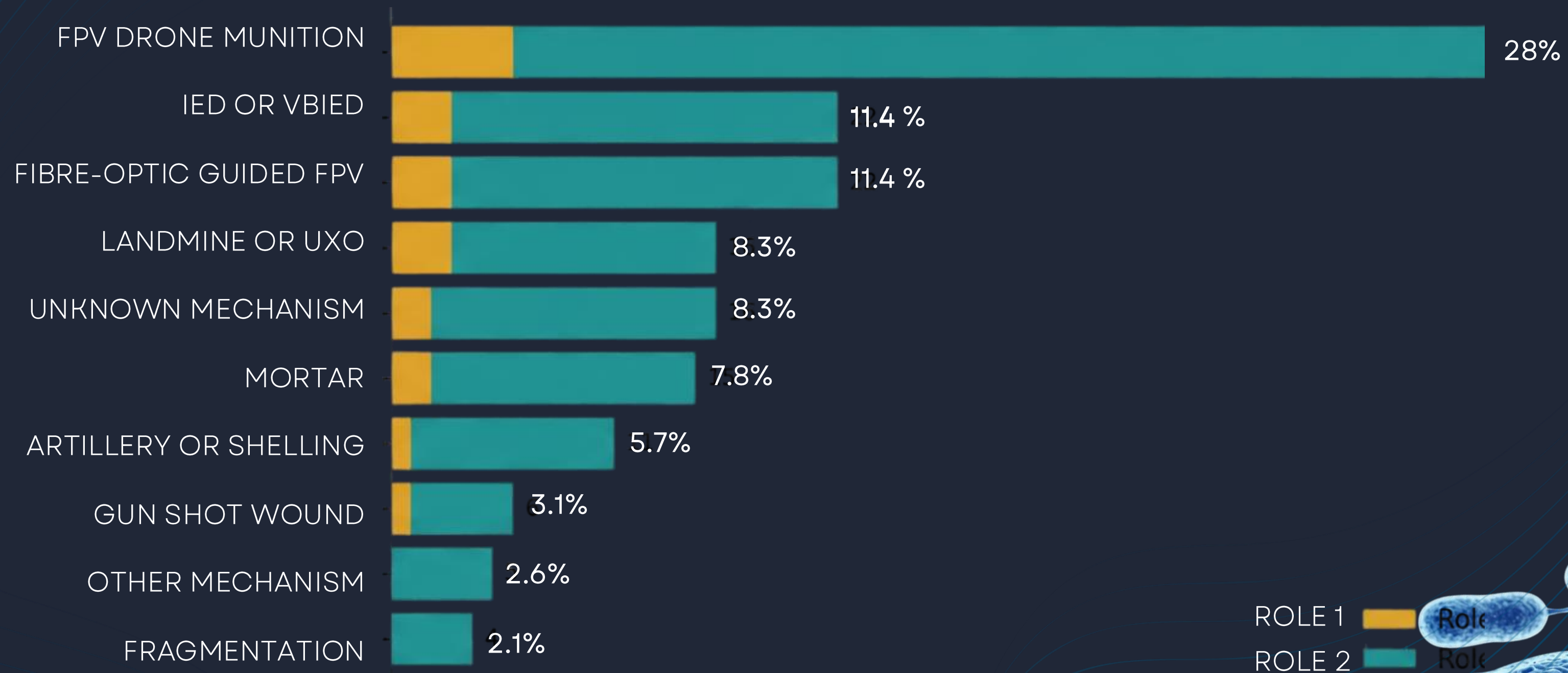




INTERIM FINDINGS

NOT YET STATISTICALLY SIGNIFICANT TO DRAW CONCLUSIONS

Leading recorded injury mechanisms





INTERIM FINDINGS

NOT YET STATISTICALLY SIGNIFICANT TO DRAW CONCLUSIONS

ESBL

PRE-DEPLOYMENT
16% ESBL detected

ROLE 1
26.1% ESBL detected

ROLE 2
21.3% ESBL detected

MRSA

PRE-DEPLOYMENT
0% MRSA detected

ROLE 1
3.8% MRSA detected

ROLE 2
2.4% MRSA detected

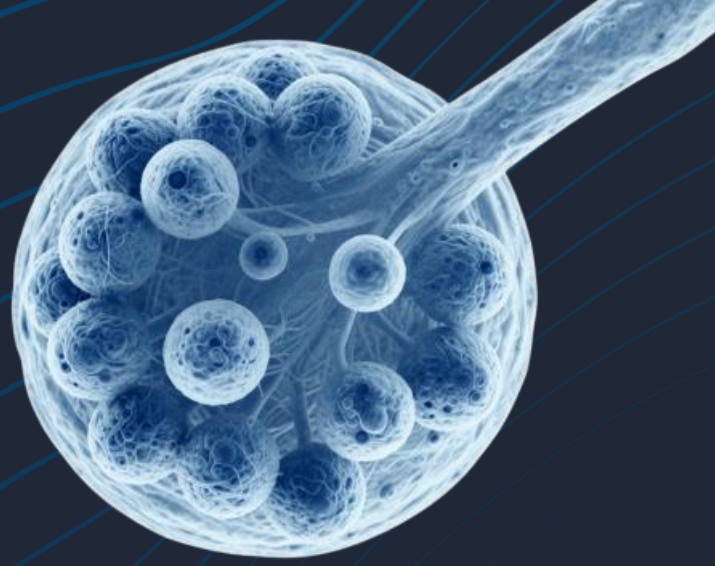
CRO

PRE-DEPLOYMENT
0% CRO detected

ROLE 1
0% CRO detected

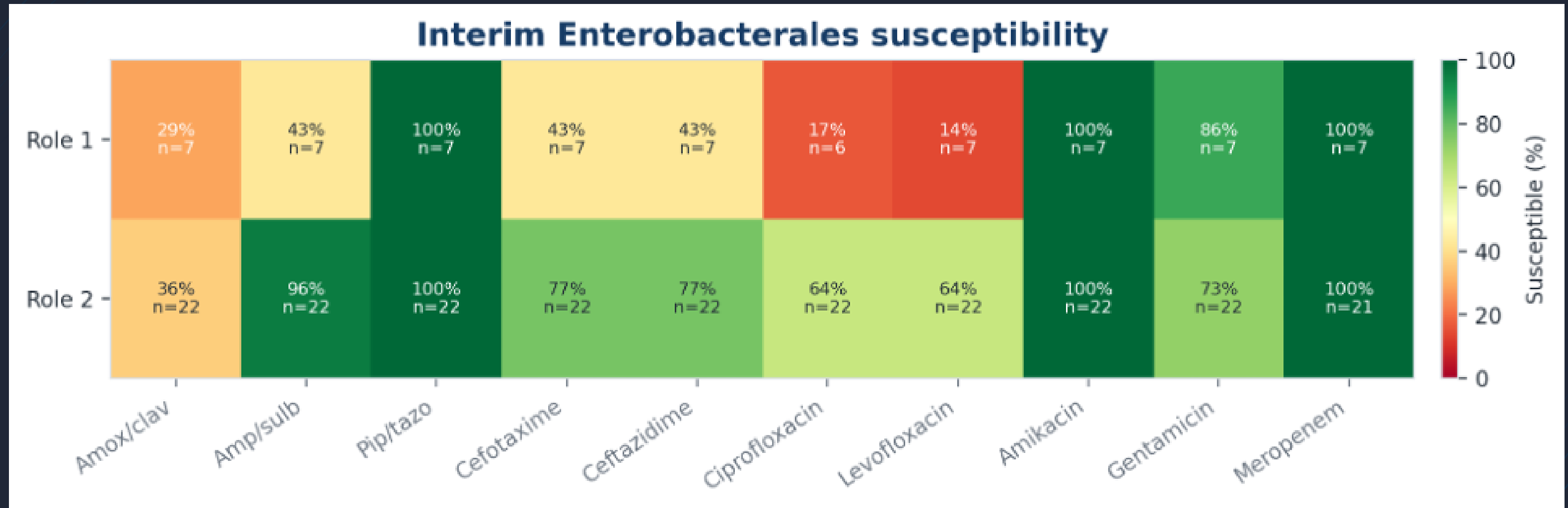
ROLE 2
0.6% CRO detected

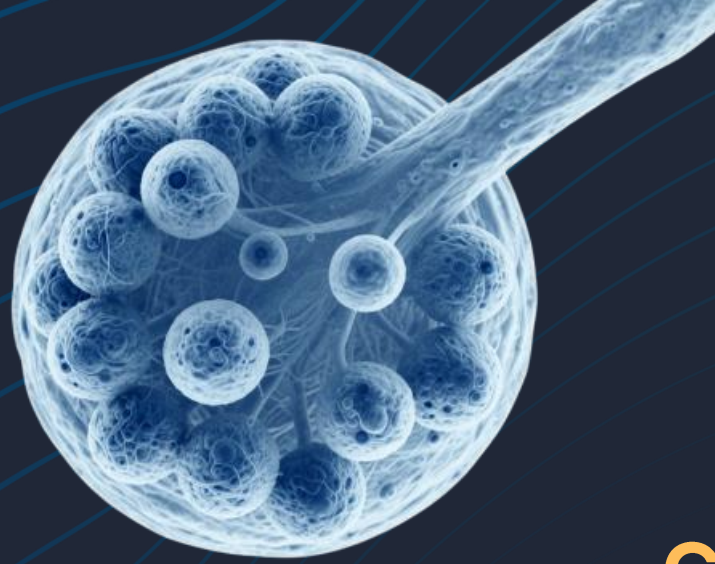




INTERIM FINDINGS

NOT YET STATISTICALLY SIGNIFICANT TO DRAW CONCLUSIONS





INTERIM FINDINGS

NOT YET STATISTICALLY SIGNIFICANT TO DRAW CONCLUSIONS

Central question we hope to workshop with completion of study:

Should antibiotic policy for today's war be inherited from previous conflicts, or redesigned using prospective Ukrainian battlefield data?

- Are pre-Role 3 antibiotics covering the organisms actually moving through Ukraine's evacuation pathway?
- Where are ESKAPE organisms first acquired: before deployment, at the point of injury, or during evacuation?
- Is cephalosporin-only prophylaxis sufficient, or should selected casualties receive a risk-stratified BL/BLI strategy?
- Is early antibiotic exposure preventing infection, or selecting resistant organisms that persist to Role 3?
- **Could alternative infection prevention strategies reduce both MDRO transmission and reliance on broader antibiotics?**
- At what evidence threshold should battlefield antibiograms begin changing Medical Brigade guidance?



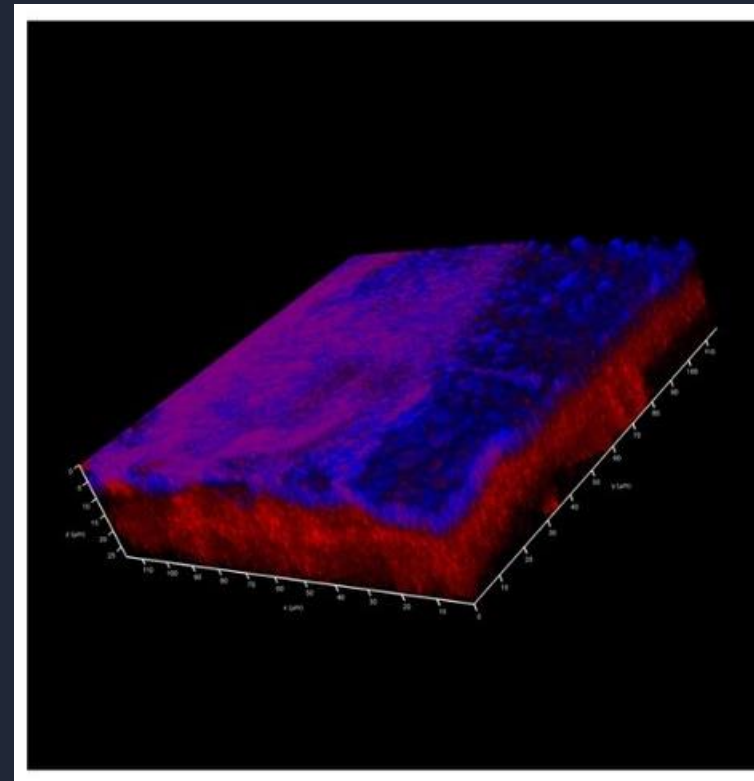
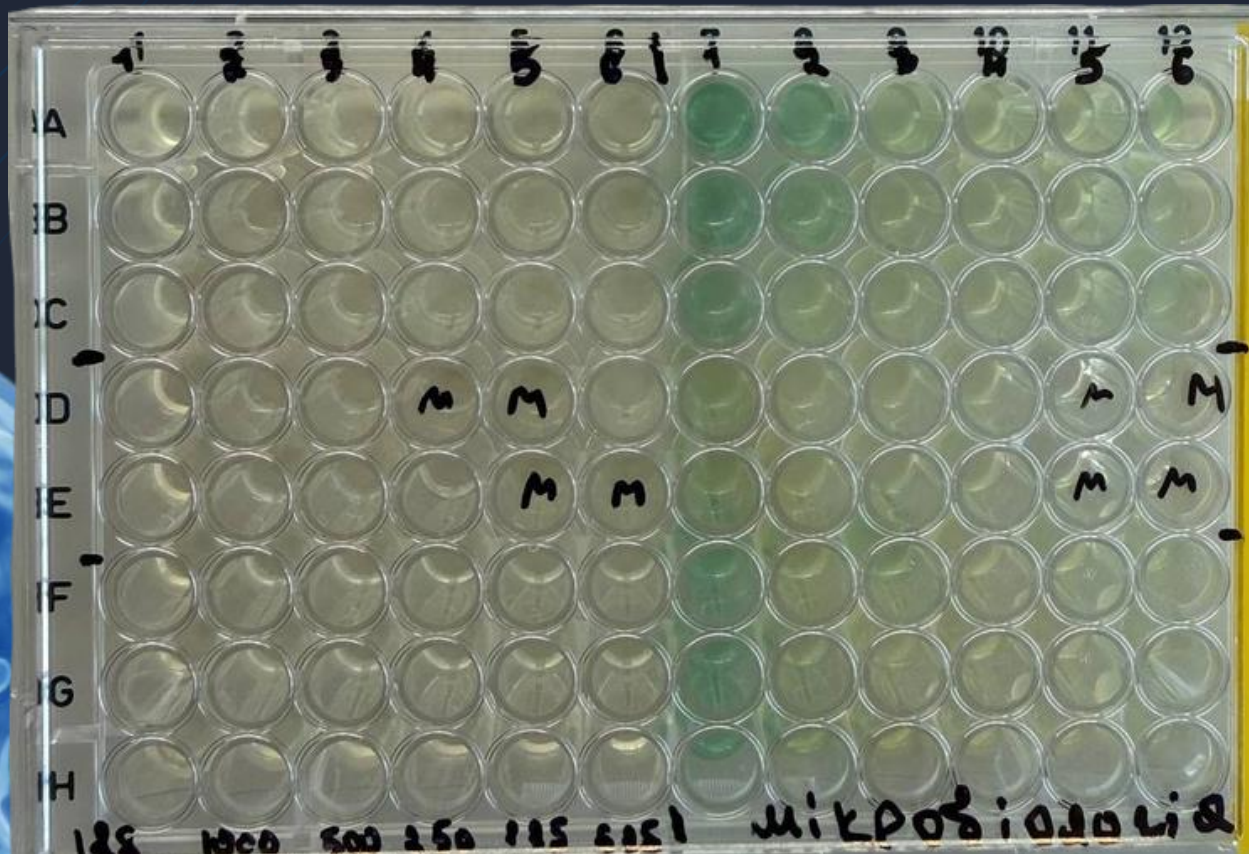
SURVEILLANCE IS IMPORTANT,

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

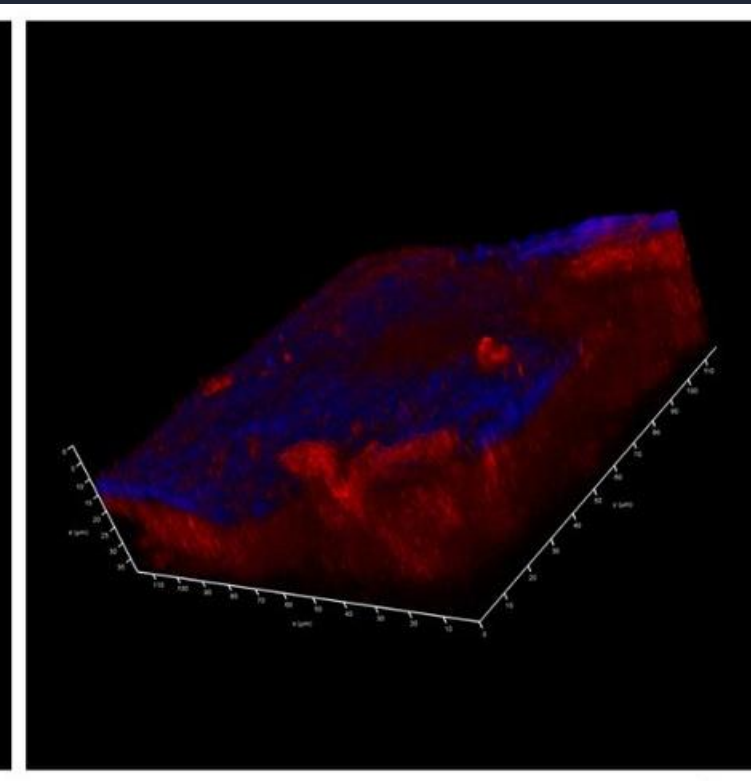
GIVEN THE PROLONGED EVACUATION TIME: SHOULD WE BE EXPLORING ADDITIONAL INTERVENTIONS TO PREVENT SYSTEMIC INFECTION?

INVESTIGATION OF ANTISEPTIC EFFICACY AGAINST BIOBANKED CLINICAL MDRO ISOLATES TAKEN FROM WAR-WOUNDED CASUALTIES

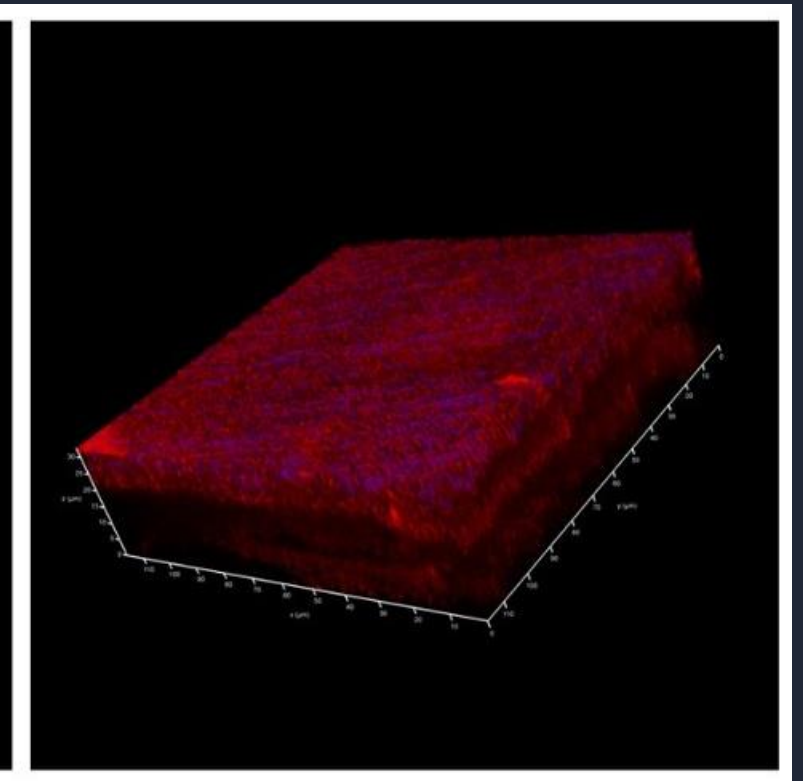
2-day old biofilms produced by Carbapenem-resistant *P. aeruginosa*



Control polystyrene
surface



Polystyrene surface with
62.5 µg/mL collagen



Polystyrene surface with
125 µg/mL collagen

GIVEN THE HIGH RATES OF UNTREATABLE INFECTIONS

WHY ARE WE WAITING FOR LAB RESULTS AND SYMPTOMS TO BE ATTEMPTING TO **PREVENT** THE INFECTIONS?

A VAP SPUTUM SAMPLE OF A WAR-WOUNDED 45km from the border of the EU.



PULMONARY MANIFESTATIONS

Symptom	CS Gas	Chloropicrin	<i>Klebsiella pneumoniae</i>	<i>Pseudomonas aeruginosa</i>	Dirty Bomb (RDD)	Orphan Radioactive Sources	Nuclear Power Plant Explosion
Cough	✓	✓	✓	✓	✓	✓	✓
Throat irritation	✓	✓	—	—	✓	✓	✓
Dyspnoea	✓	✓	✓	✓	✓	✓	✓
Chest tightness	✓	✓	✓	✓	✓	✓	✓
Wheezing / broncho-spasm	✓	✓	✓	✓	—	—	—
Pulmonary edema	—	✓	✓ (in severe cases)	✓	✓ (high-dose)	✓ (high-dose inhalation)	✓ (in radiation pneumonitis)
Radiation pneumonitis	—	—	—	—	✓	✓	✓
Hemoptysis	—	✓ (severe)	✓	✓	✓ (late effect)	✓	✓

Антибіотик	Мікроорганізм 1 <i>Proteus mirabilis</i>	Мікроорганізм 2 <i>Klebsiella pneumoniae</i>	Мікроорганізм 3 <i>Pseudomonas aeruginosa</i>	Мікроорганізм 4 <i>Providencia stuartii</i>	Мікроорганізм 5 <i>Stenotrophomonas maltophilia</i>
Ампіцилін	стійкий	-	-	-	-
Амоксицилін	стійкий	-	-	-	-
Амоксицилін/клавуна́т	стійкий	стійкий	-	-	-
Піперацилін/тазобактам	чутливий	стійкий	стійкий	-	-
Тікацилін/клавуна́т	чутливий	-	стійкий	-	-
Цефуроксим	стійкий	стійкий	-	стійкий	-
Цефотаксим	стійкий	стійкий	-	стійкий	-
Цефтріаксон	стійкий	стійкий	-	стійкий	-
Цефтазидим/авібактам	чутливий	стійкий	-	стійкий	-
Цефепім	стійкий	стійкий	стійкий	Помірно чутливий	-
Цефідерокол	чутливий	чутливий	чутливий	чутливий	чутливий
Амікацин	стійкий	стійкий	стійкий	стійкий	-
Гентаміцин	стійкий	стійкий	-	стійкий	-
Тобраміцин	стійкий	стійкий	стійкий	стійкий	-
Пефлоксацин (скринінг)	стійкий	стійкий	-	стійкий	-
Ципрофлоксацин	стійкий	стійкий	стійкий	стійкий	-
Моксифлоксацин	стійкий	стійкий	-	стійкий	-
Левовфлоксацин	стійкий	стійкий	стійкий	стійкий	-
Меропенем	чутливий	стійкий	стійкий	чутливий	-
Імідазепім	чутливий	стійкий	стійкий	чутливий	-

COULD WE TRY TO REDUCE MDRO SPREAD WITH A BIOLOGICAL-WARFARE INSPIRED DECONTAMINATION PRE-ROLE 3?

- 80% OF CASUALTIES MOVE TO A ROLE-3 LEVEL CAPACITY IN A CIVILIAN HOSPITAL
- INFECTION PREVENTION CONTROL TEAMS ARE IN THEIR INFANCY AND RECEIVE HEAVILY CONTAMINATED CASUALTIES DAILY, WITH A NURSING RATIO OF 1:30-60
- THE CASUALTY HAS BEEN FURTHER EVACUATED BEFORE MICROBIOLOGICAL CONFIRMATION OF INFECTION → IRRATIONAL BROAD-SPECTRUM ANTIBIOTIC PRESCRIBING

1

The Public Health Center continues to mature IPC & AMS teams across hospitals

Let's keep in mind the US had implemented IPC in the 70s yet still introduced "Iraqibacter"

2

We layer on top pre-hospital full decontamination with full-scale simulation training

Partnership with Medical and CBRN Special Forces of NATO

3

We implement and study the safety, efficacy and efficiency of the intervention

We must not create bottlenecks, cause patient harm or delay urgent treatment

4

We measure the outcomes of the patients

Not just HAI (VAP, SSI, CAUTI, CLABSI), but microbiome changes, biochemistry, surgical interventions, admissions to ICU compared with a control facility

5

We adapt the concept for high-risk target military medical contexts

Can we do this within existing infrastructure?
Can we do this underground?

THE 4-DAY FULL SCALE SIMULATION IN PARTNERSHIP WITH US, BELGIAN AND POLISH SPECIAL FORCES MEDICAL & CBRN TEAMS



MANUSCRIPT IN PROGRESS

- ~15 minutes/casualty
- Each Ukrainian accredited by checklist assessment of competency and completeness of necessary interventions
- The Ukrainian team felt significantly it could be implemented pre-role 3 facility
- Surgeon General of Medical Command of the Armed Forces of Ukraine participated, and strongly supports implementation across as many facilities as possible in Ukraine

A biological-warfare inspired decontamination unit in situ in Ukraine



NECESSITY HAS DRIVEN INNOVATION

Russia's protracted war against Ukraine has accelerated the development and adaptation of weapons, unmanned systems, electronic warfare and battlefield tactics at unprecedented speed.

Military medicine must evolve at the same pace.

Ukraine is translating operational necessity into new approaches to casualty surveillance, infection prevention and care across a prolonged and contested evacuation pathway. Sustaining this work will require partners prepared to invest in medical capability that keeps pace with the changing character of war.

Innovation in survivability must advance as rapidly as innovation in warfare.



WHAT DOES SUCCESS IN THIS PROJECT MEAN?

1. Saving Lives and Salvage Limbs in Ukraine

Reduce infection, sepsis, infection-related amputation, and mortality among war-wounded casualties.

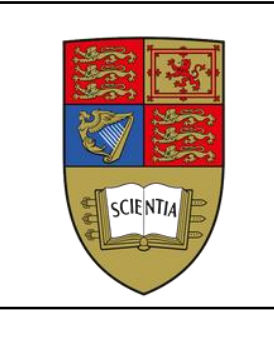
2. Protecting the biosecurity of Europe and beyond

Reduce the international spread of highly resistant pathogens before they become entrenched within healthcare systems across Europe and beyond.

3. Preparing partner and allied countries for future conflict:

Developing and validating the medical capabilities that allied and partner nations will require in future LSCOs

UKRAINE IS TEACHING THE WORLD HOW TO FIGHT HELP US
ENSURE IT ALSO TEACHES THE WORLD HOW TO SAVE LIVES.

	Hailie Uren Master Disaster Medicine, Clinical pharmacology Sweden and Clinical Pharmacy Australia, Since 2023, I have been advising on infection treatment in war-wounded in Lviv, Ukraine.		Ulyana Pidvalna Associate Professor of Anatomy at LNMU, scientific consultant, and editor, collaborates with European Radiology and the Lviv Heart Center.		Col. Roman Kuziv Associate professor at the Dept. for General Surgery. Director of Centre for Disaster Medicine.
	Colonel Dr Humeniuk Chief Surgeon of the Ukrainian Military		Volodymyr Kovalchuk Assistant Professor in the Department of Orthopaedics and Traumatology No 2 at Shupyk National Healthcare University, Orthopaedic limb reconstruction specialist		Yvette Godwin Plastic Reconstructive Surgeon from Cambridge University. Has done extensive work in Gaza and Ukraine
	B. Hudson Berrey Retired Colonel from the U.S. Army Medical Corps, Orthopaedic Consultant to the Army Surgeon General, prior Chief of Orthopaedics at Walter Reed National Military Medical Center		Ihor Kuzin Deputy Minister of Health of Ukraine and the Chief State Sanitary Doctor		Dr Dmytro Samofalov Director of Health within the Ministry of Defence
	John B. Holcomb Colonel of the US Army Medical Service (retired), former Chief Surgeon of the US Special Operations Command.		EU-SOF		Chief of Medical Service of the 3rd Army Corps Viktoria Kovach + Medical Command team
	Dmytro Beshley Chief Surgeon in the Trauma Stabilisation and Role 3 Hospitals in the Trauma Evacuation Pathway/ Cardiothoracic Surgeon in Lviv		Shehan Hettiaratchy Consultant Plastic and Reconstructive Surgeon, part of Imperial College Healthcare NHS Trust		Municipal Non-Profit Enterprise «City Clinical Hospital № 4
	Elena Moshynets Senior Researcher, Biofilm Study Group, Department of Cell Regulatory Mechanisms, Institute of Molecular Biology and Genetics, NAS of Ukraine (Kyiv).		Major General Anatoliy Kazmirchuk The Major General of the Medical Command of the Armed Forces of Ukraine		US-Special Operations

THANK YOU,
ДЯКУЮ

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- Principal investigator of an 8 phase combat casualty care innovation project in collaboration with the Ministry of Defence of Ukraine