DARPA TRIAGE CHALLENGE

Jeremy Pamplin, MD

Program Manager

Biological Technologies Office

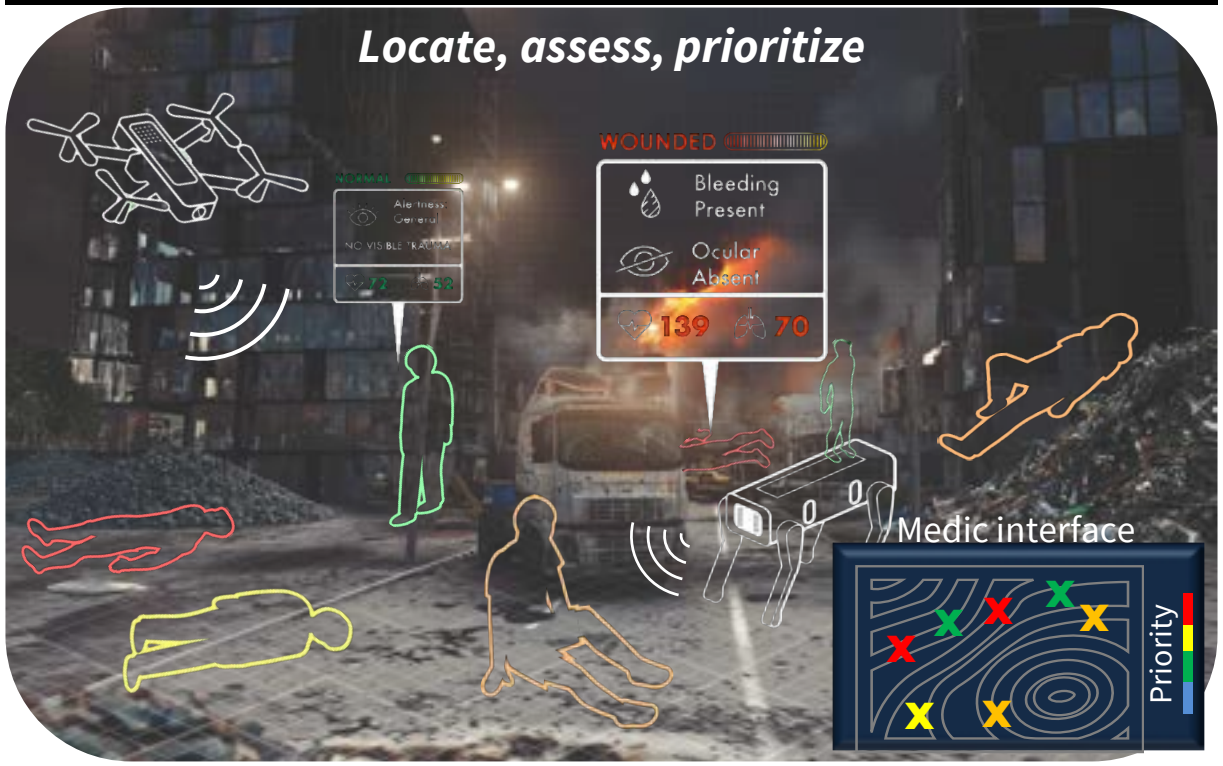
DARPA TRIAGE CHALLENGE

Goal: Drive breakthrough innovations in identification of signatures of injury for ***scalable, timely,*** and ***accurate*** triage in mass casualty events

DARPA Triage Challenge

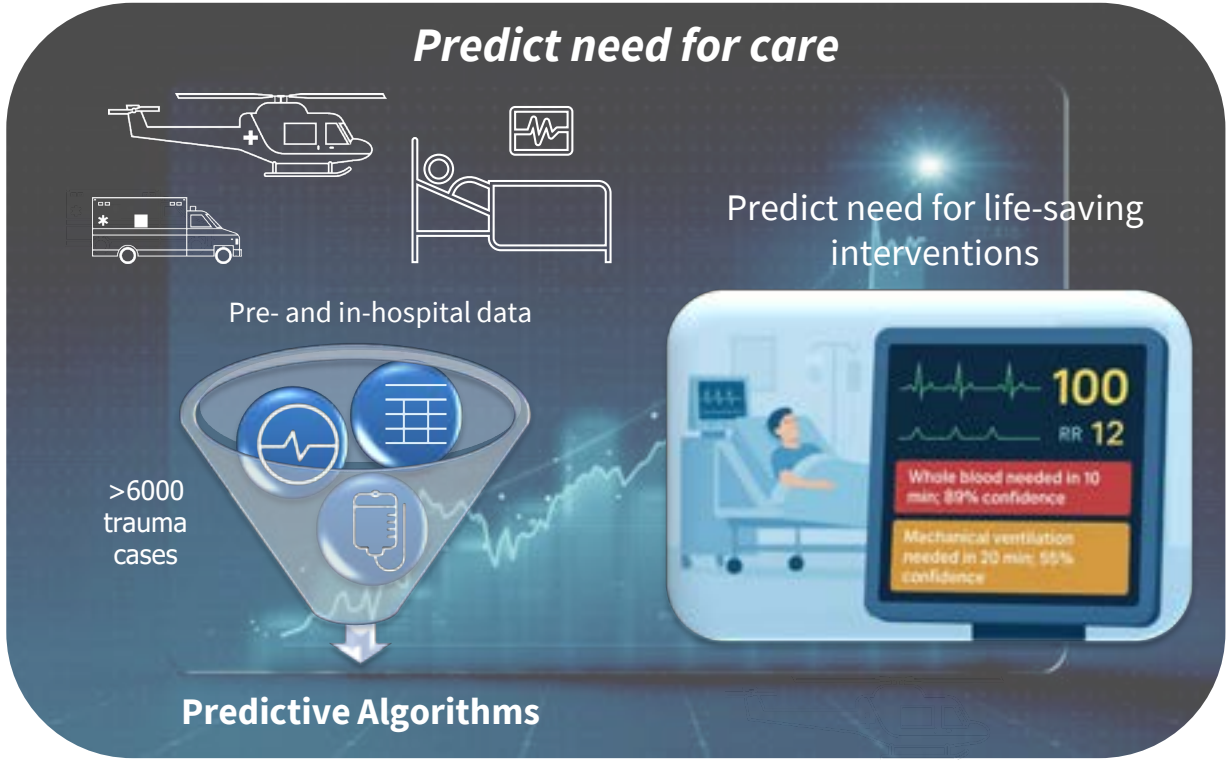
DoD Problem: Current triage approaches are inadequate for mass casualty incidents and have limited value for predicting need for life-saving medical interventions.

Systems Competition



Primary Triage – Point of injury, medical providers sort casualties by injury severity

Data Competition



Secondary Triage – Resuscitation and administration of life-saving interventions en route and at the trauma center.

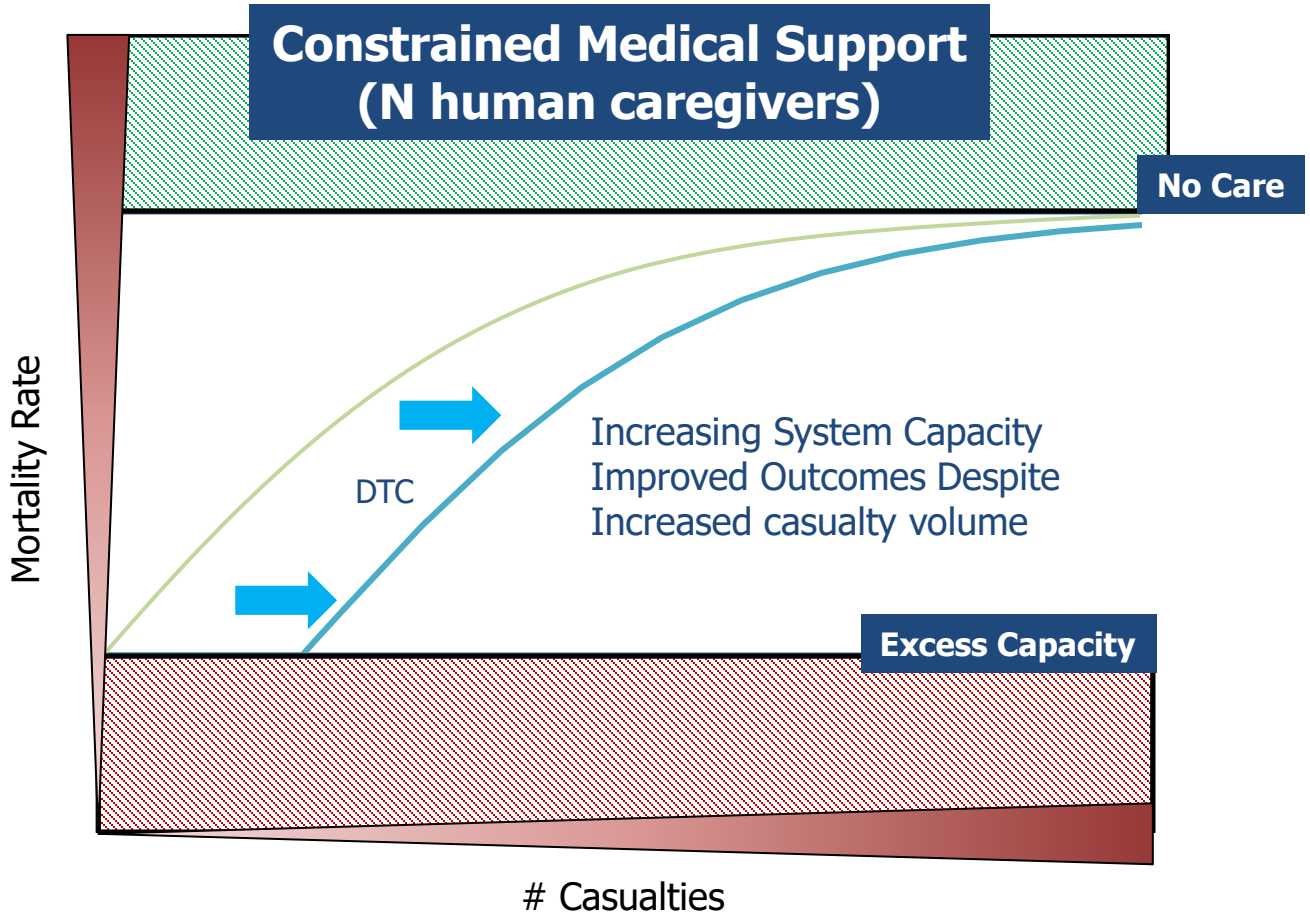
DTC solves performance problems across the pre-hospital triage timeline

Triage stage	Performance attribute	Current practice	DTC
Primary	Hands-on evaluation	all casualties	priority casualties
Secondary	Subjectivity	high	low
Secondary	Predictive value	low-moderate	high
Primary & Secondary	Scalability	low	high

DTC impact on triage

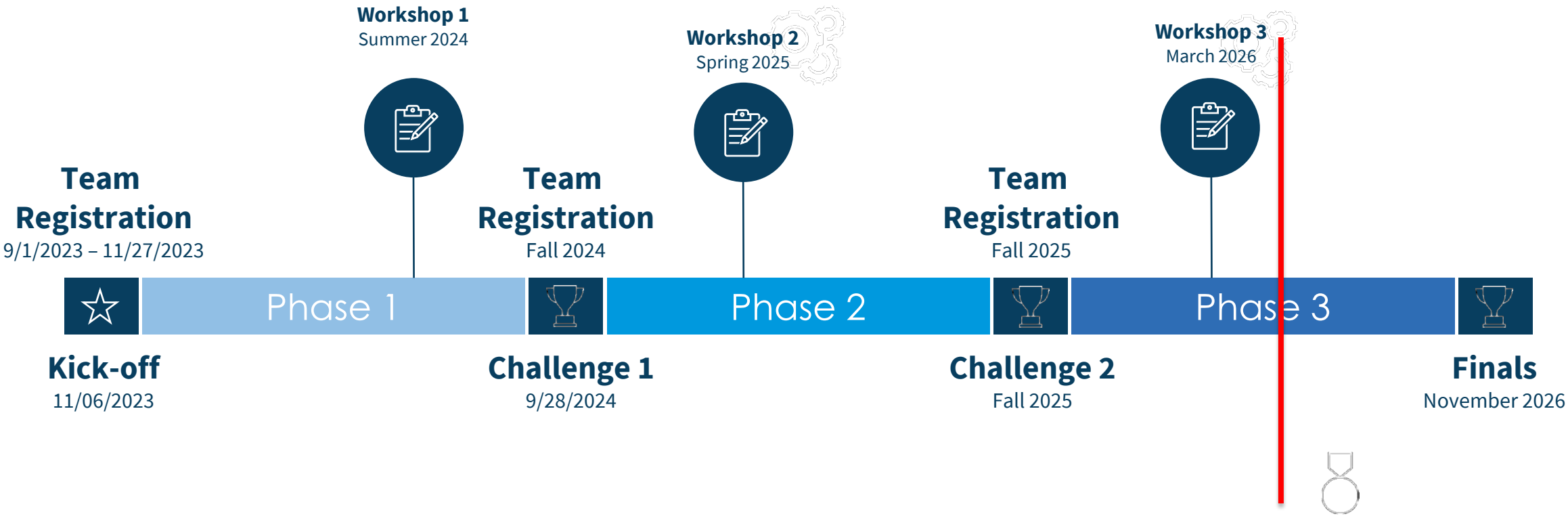
- Makes finding casualties faster
- Prioritizes care faster
- Medics can plan more efficiently

Time Saved = Lives Saved



DTC Goal: Capture of novel injury signatures to improve MCI triage timeliness, accuracy, and prediction through out the triage timeline, improving the number of lives saved.

Challenge Timeline – Where are we now?



Prizes

Challenge I
Fall 2024

Prizes	Systems [self-funded]	Data [self-funded]	Virtual [self-funded]
1st	$120,000	$120,000	$60,000
2nd	$60,000	$60,000	$30,000
3rd	$20,000	$20,000	$10,000

Challenge II
Fall 2025

Prizes	Systems [self-funded]	Data [self-funded]
Ist	$300,000	$300,000
2nd	$150,000	2nd $150,000
3rd	$50,000	3rd $50,000

Challenge III
Fall 2026

Prizes	Systems	Data
Grand	$1,500,000†	$1,000,000†
1st	$300,000*	
2nd	$150,000*	
1st Each Gate	$12,500	

†All teams
*Self-funded teams only

Systems Competition – Increasing difficulty

Guardian Centers, GA

Disaster City, TX

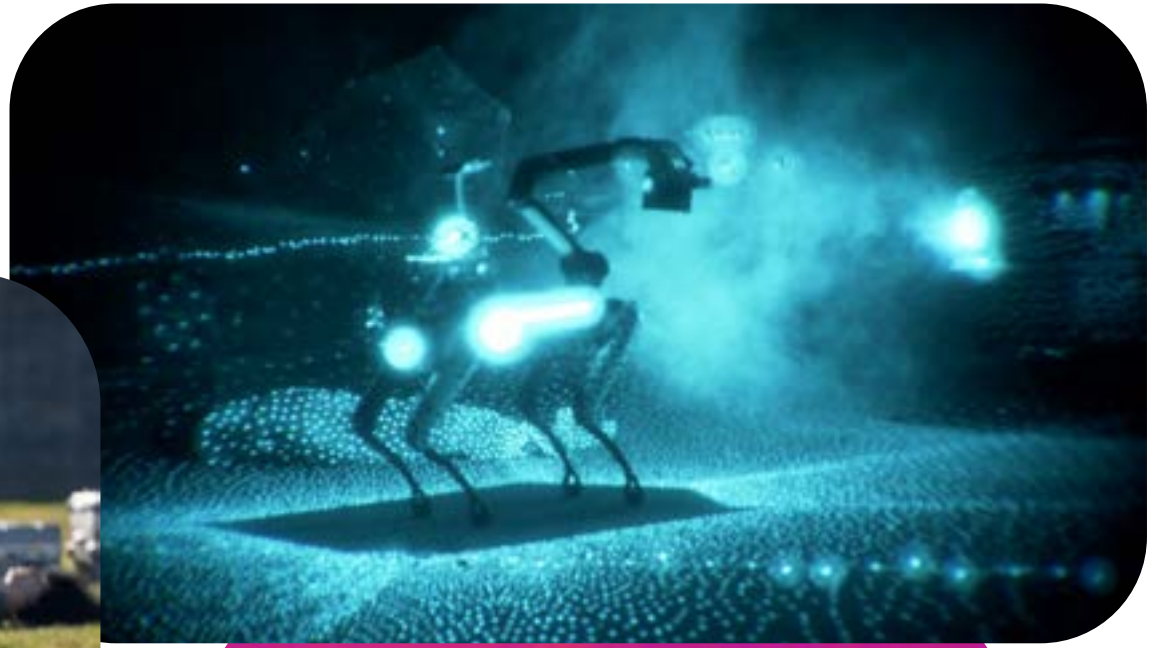
Scenario Condition	Competition 1	Competition 2	Finals
Casualties per course	9 - 18	18 - 30	Up to 50
Environmental challenges	• Navigation through grass, mud, asphalt, ash, etc. • Daylight with good visibility • Fiduciary support for localization	• Navigation through grass, mud, asphalt, ash, etc. • Nighttime / low light • Smoke / dust / fire pit • No fiduciaries for localization	• Navigation through grass, mud, asphalt, ash, etc. • Multi-level structure, large rubble pile • Large variations in lighting • Smoke / dust / fire pit
Casualty Placement and Presentation	• Casualties respond to verbal prompts • Well-separated casualties • Casualties are stationary • No change in physiology during scenario • Casualties protected under mesh shelters	• Casualties respond to verbal prompts • Co-located casualties • Walking wounded with movement perimeter • Realistic physiological decline/improvement during scenario	• Casualties respond to verbal prompts • Co-located casualties • Realistic physiological decline/improvement • **Teaming with medics**
Occlusions	• None	• Partially occluded casualties (e.g., rubble, obstacles, smoke)	• Some **fully occluded** casualties (e.g., rubble, obstacles, smoke)
# Systems and Autonomy	• 5 systems, autonomy not required	• 5 systems, autonomy preferred	• 10 systems, **autonomy required**

Injury patterns: TBI; Penetrating Wounds; Burn; Respiratory Distress; Severe Hemorrhage; Polytrauma; Amputations

TBI, Traumatic Brain Injury

Year 2 courses

[DARPA Triage Challenge Workshop 2]



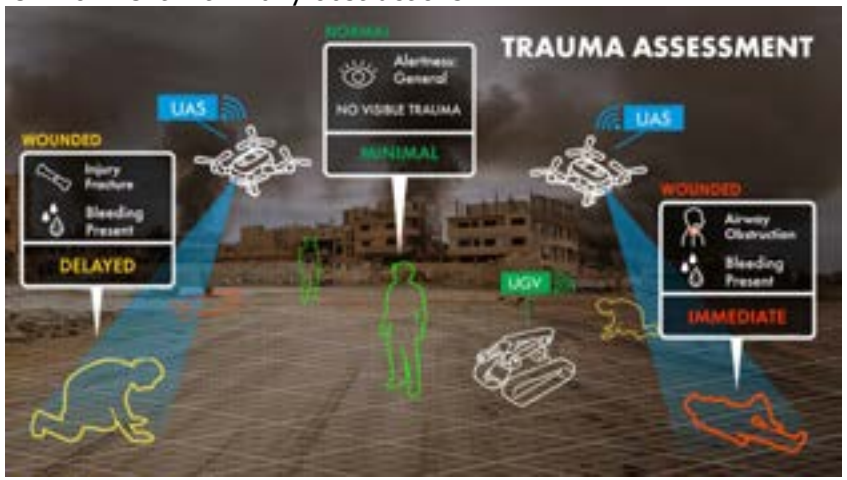
Guardian Centers, GA

Workshop 3 Courses

Guardian Centers, GA

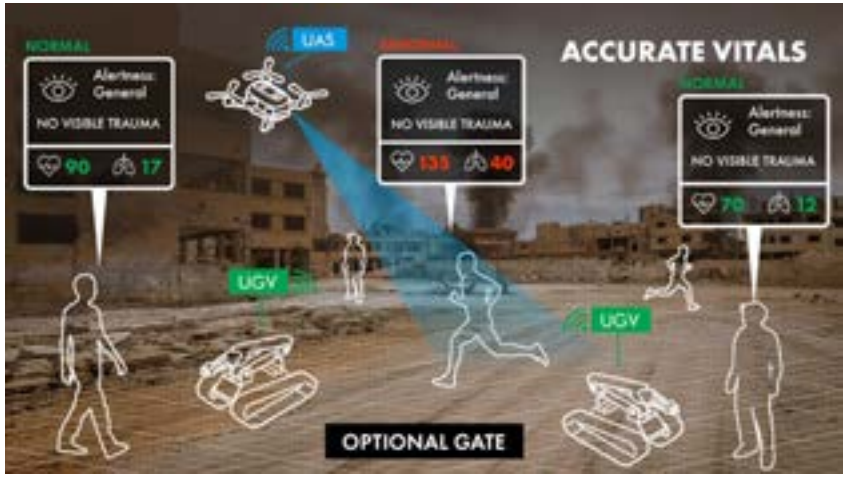
Courses – Component testing gates

Find and Locate: Platforms must autonomously locate as many casualties as possible, as quickly as they can in a complex environment with many obstructions.



Trauma Assessment: Using sophisticated onboard sensors, teams will report on injury types and casualty locations.

Rapid Triage: When every second matters, teams must rapidly identify critically injured casualties.



Accurate Vitals: Teams will accurately report on vital signs such as heart and respiration rates. Scores from this optional gate will add to the aggregate score for teams choosing to participate.

Human Machine Teaming Course – Systems testing

The goal of the human machine teaming lane is to determine how autonomous sensing platforms can help medics perform more accurate and timely triage.

Teams will operate their systems autonomously through complex environments on both a **day** and **night** course.

Human-Machine Teaming

Competitor teams deploy their autonomous systems at the start of course run.

Medics deploy 5 minutes into the course run and review team-provided information (TAK-compatible) before starting triage.

Medics are allowed to interact with autonomous systems. Their movements are monitored with GPS.

Prizes and Elimination

$12,500 each Gate

First Place
$300,000

Second Place
$150,000

Gates

12 Teams

Gate Finals

8 Self-Funded Teams

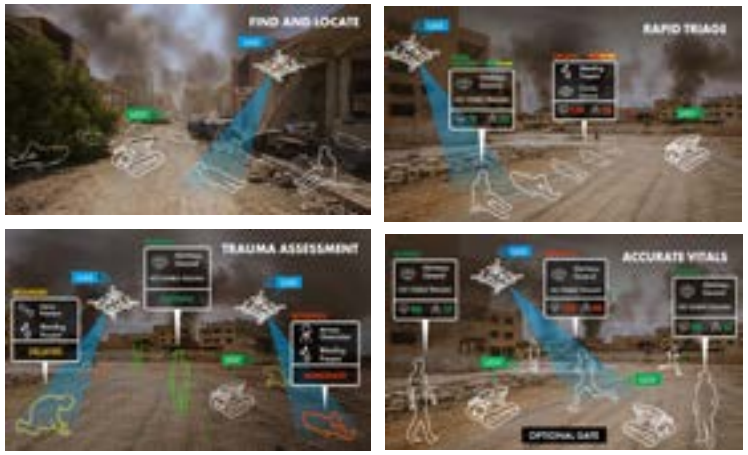
Human Machine Teaming

4 Teams

Championship

2 Teams

Grand Prize
$1,500,000

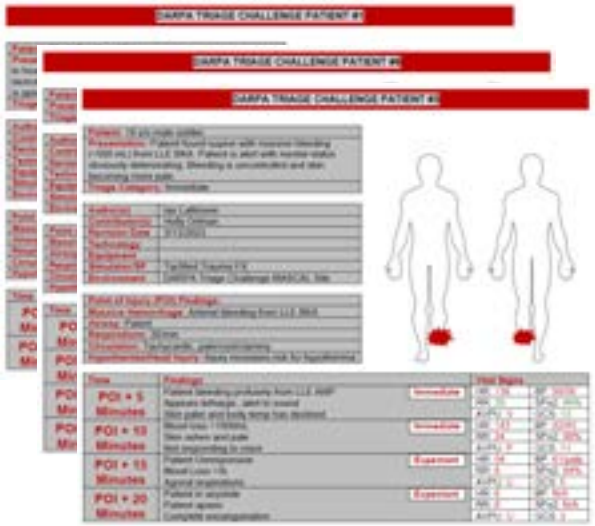


Mass casualty MEDSIM at scale

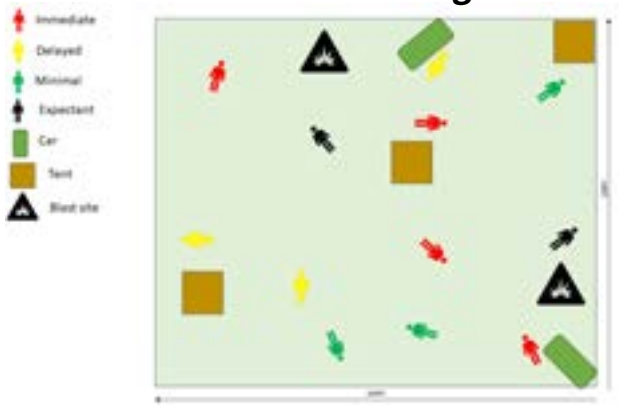
DARPA TRIAGE CHALLENGE

Creating a Storyline

Custom designed casualty presentations



Scenario design



Generating Ground Truth

Ground Truth Sensors

Respiration using Vernier Chest Straps. The transducer is designed to measure changes in chest diameter resulting from breathing.

Heart rate using Polar chest band sensors to detect HR using Electrocardiogram tech.

Moulage

Scoring in Command Center

Sensor Monitor Tracking

Each actor's location and biometric data tracked in real time

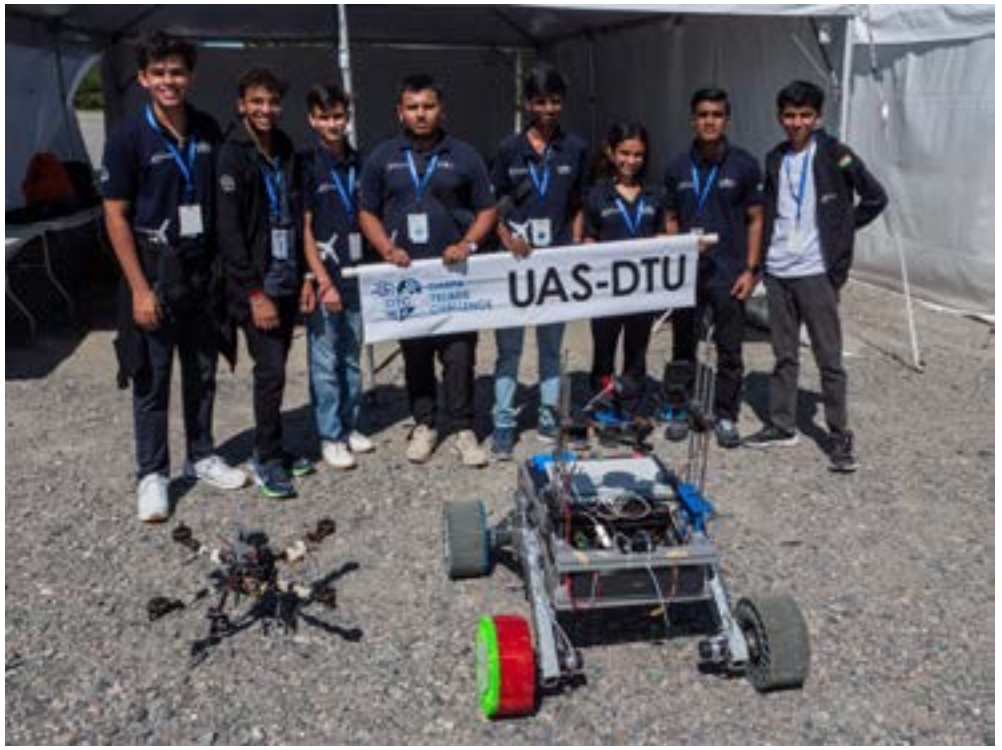
Live scoring server

Overhead view of the course
Each casualty is identified by their number

Monitoring and scoring infrastructure developed by NIWC – Atlantic, IV&V Partner

Systems Competition Teams

A maximum of 12 teams will compete at the Finals



Systems Teams Strategies

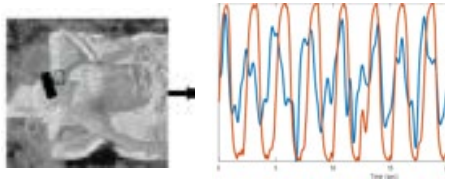
- UAV-only, UGV-only, mixed platforms
- Verbal prompts and audio capture, analysis using LLMs
- Machine-vision based person, pose detection (YOLO)
- Heart rate and respiration rate measured by minute change in color (RGB cameras) or movement (IR/RGB cameras, radar)

EO Cameras

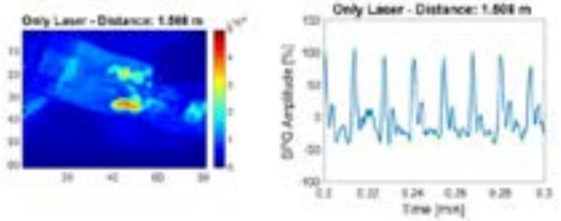
Radar detection, evaluation of casualties

Verbal interaction with casualties with microphone and speakers

IR detection of respiration



Stand-off capture of heart rate and waveforms on forearm by laser speckle contrast imager



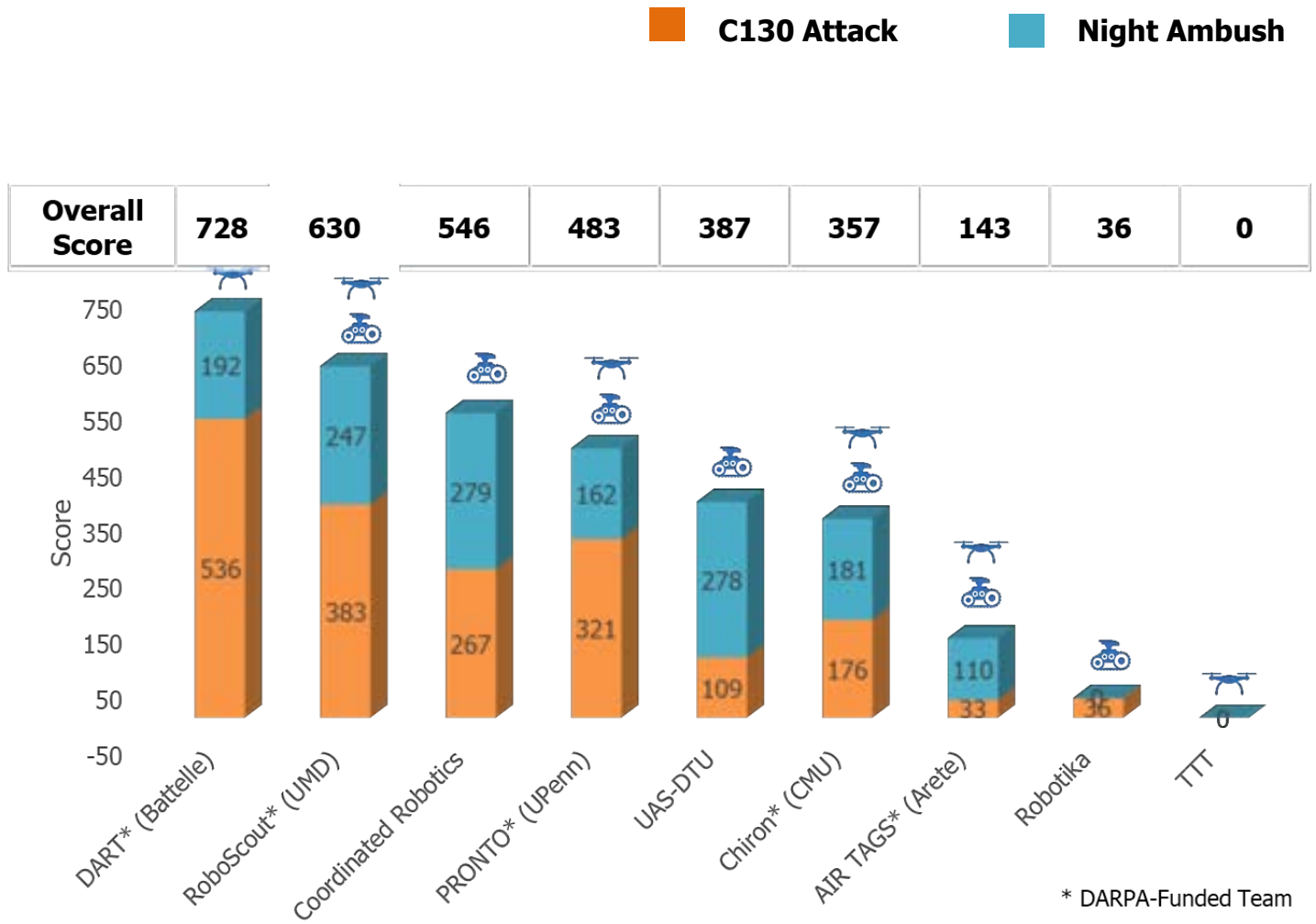
Systems Competition Year 2 Leaderboard

Scoring Criteria

Location[1]	(latitude, longitude)
Severe Hemorrhage[1]	[present, absent]
Respiratory Distress[1]	[present, absent]
Vitals[1]	**HR** ± 3 BPM **RR** ± 5 BrPM
Trauma	**Head:** [wound, normal, Not Testable (NT)] **Torso:** [wound, normal, NT] **Upper Ext.:** [wound, amputation, normal, NT] **Lower Ext.:** [wound, amputation, normal, NT]
Alertness[1]	**Ocular:** [open, closed, NT] **Verbal:** [normal, abnormal, absent, NT] **Motor:** [normal, abnormal, absent, NT]

Bonus points given for speed

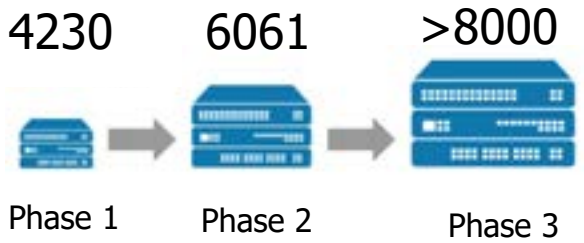
[More information]



Data Competition – predicting need for care

Pre- and in-hospital vitals data

Clinical Case Count



Tasks

- Predict need for life-saving interventions up to 4 hours after hospital admission using the first few minutes of data.
- Continuous alert with streaming data with a 15min sliding window
- Develop algorithms that can adjust to the availability of resources (e.g. civilian hospital vs forward medical tent)

Data Competition Data Collection

Research Infrastructure for Trauma with Medical Observations **(RITMO)** Program

Data description

- Pre- and in-hospital data up to 4 hrs after admission
- Expanded EHR: procedures, labs, demographics, vitals waveform data

Patient EHR

Additional Sensors

Helicopter ventilator

Pupillomentry in trauma bay

Trauma bay brain and tissue oximetry

Helicopter and trauma bay video

Collected by

R Adams Cowley Shock Trauma Center, University of Maryland

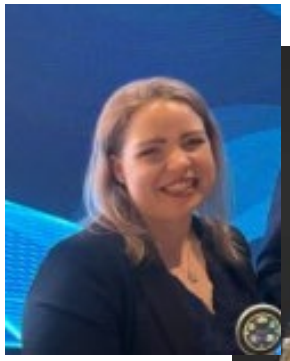
UPMC University of Pittsburgh Medical Center

Data Competition Teams and Approaches

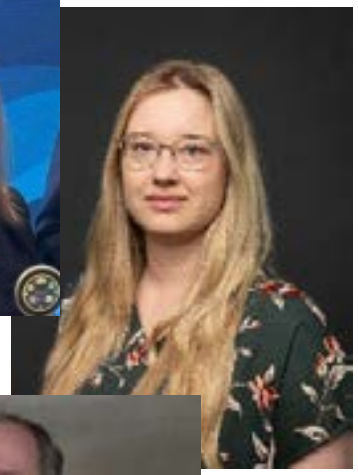
Maximum of 15 Teams will compete in the Finals

MarvsAI

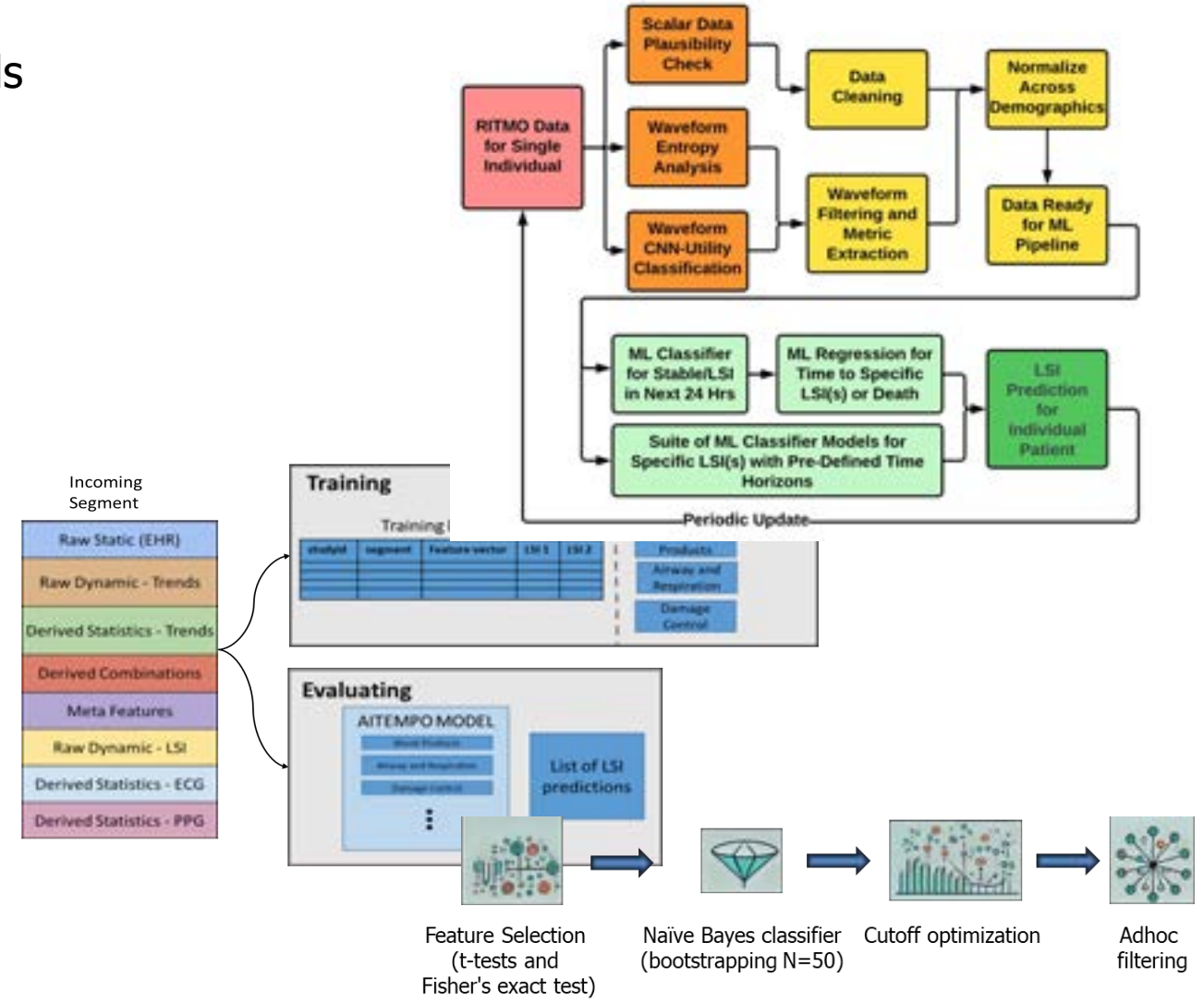
Triage360



MTU



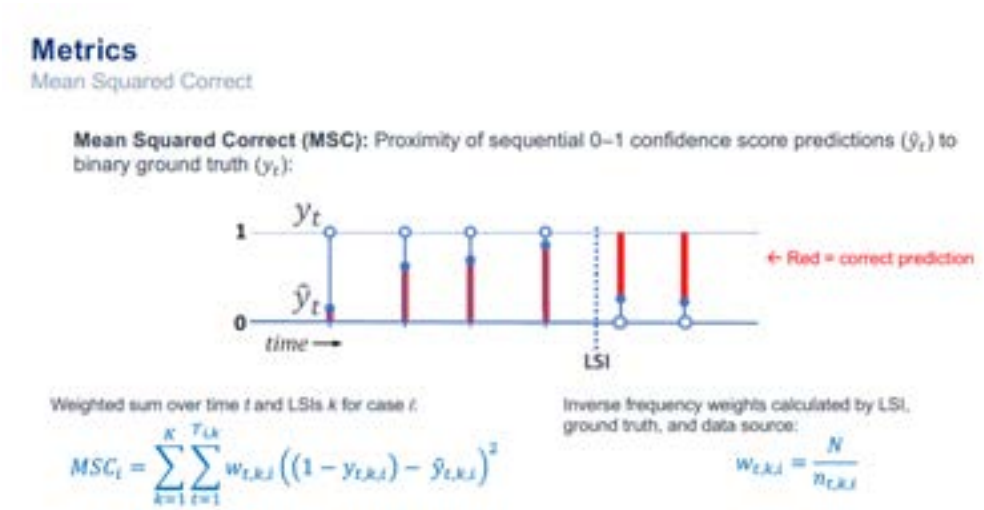
Coordinated Robotics



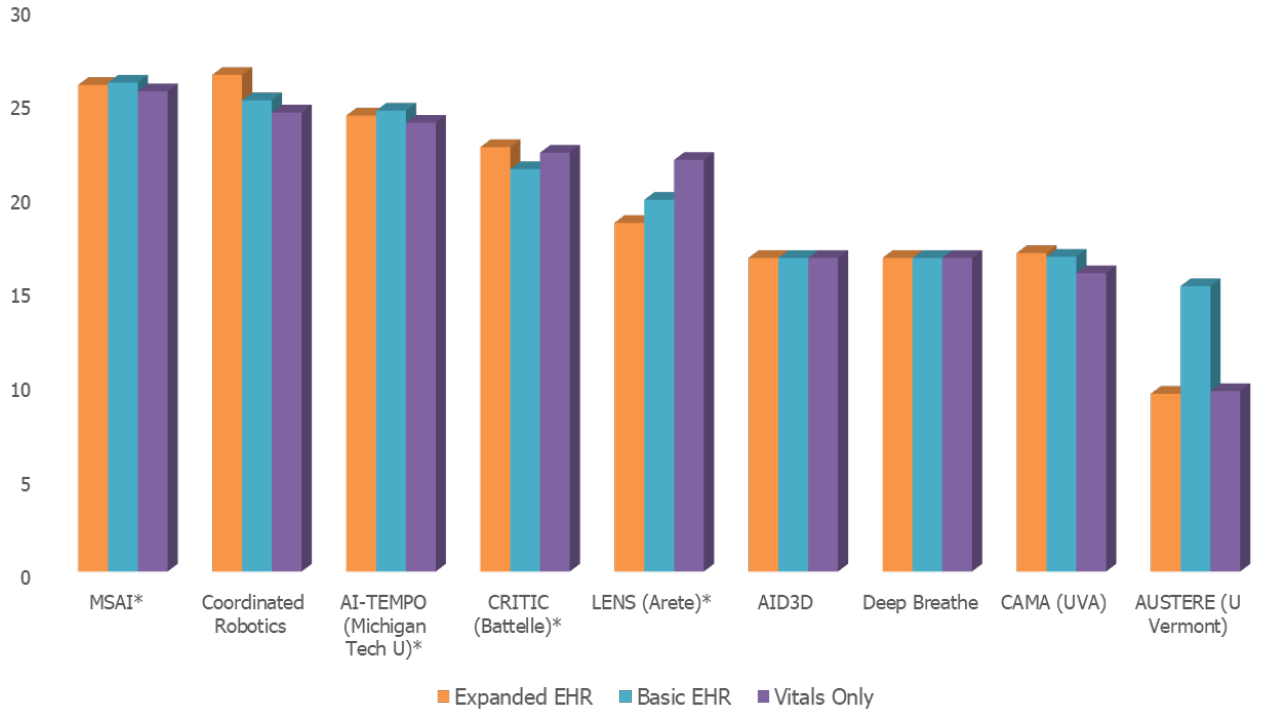
Data Competition Year 2 Leaderboard

Scoring Criteria

LSI prediction accuracy
Minimum lead time: 5min before LSI occurs



Overall Score	**77.39**	**75.86**	**72.6**	**66.22**	**60.17**	**50**	**50**	**49.53**	**34.21**



* DARPA-Funded Team

[More information]

Data Competition Performance – Year 2

9 Teams competed

Using Expanded EHR

Injury details, labs, procedures, medications

Expanded EHR	Number of Teams with Balanced Accuracy Greater than:		
LSI Target	**60%**	**70%**	**80%**
Blood Products	5	4	1
Airway and Respiration	6	4	1
Neurologic Products and Procedures	6	4	3
Damage Control Procedures	5	4	2
Chest Decompression	4	3	1
Bleeding Control	5	4	1

Using Basic EHR

Demographics, injury, GCS, EHR vitals, instantaneous labs

Basic EHR	Number of Teams with Balanced Accuracy Greater than:		
LSI Target	**60%**	**70%**	**80%**
Blood Products	7	4	1
Airway and Respiration	7	5	1
Neurologic Products and Procedures	7	5	4
Damage Control Procedures	5	4	0
Chest Decompression	5	3	0
Bleeding Control	6	4	0

Using Vitals only

Continuous waveforms and trends of vital signs

Vitals Only	Number of Teams with Balanced Accuracy Greater than:		
LSI Target	**60%**	**70%**	**80%**
Blood Products	7	5	0
Airway and Respiration	7	5	0
Neurologic Products and Procedures	6	5	2
Damage Control Procedures	4	4	0
Chest Decompression	4	2	0
Bleeding Control	4	3	0

Virtual Competition (ended in Year 2)

Source of Physiological Signs & Symptoms (S&S)
Indicators of clinical features:
- Vital signs
- Visual
- Audible

BioGears
Source of physiology for visual signs and symptoms

Unreal Metahumans
- Avatar generation
- Audio / visual signal assignation

Unreal Game Engine
- Visual Environment
- Signal disruptors / deviations

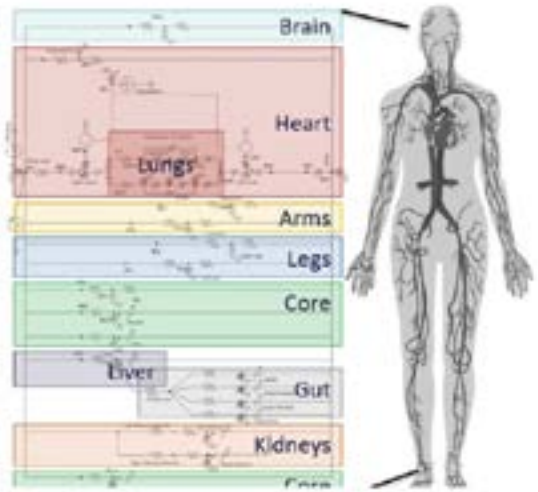
Virtual Causality Representation
Sensor detectable signals

Virtual Stand-off Sensors
Capturing of physiological data
- RGB camera
- Thermal camera
- Microphone

Sensor Algorithms*
Analyze detected sensor data to identify injury patterns for triage

*Competitors' Task

Physiology Engine - BioGears



BioGears is an open-source human physiology engine developed by ARA to advance medical training and research. It uses lumped parameter models that enable complex physiological systems to be represented with electric analog components. DARPA is enhancing BioGears with injury models, sensors, platforms, and environmental effects.

Unreal engine 5 environments

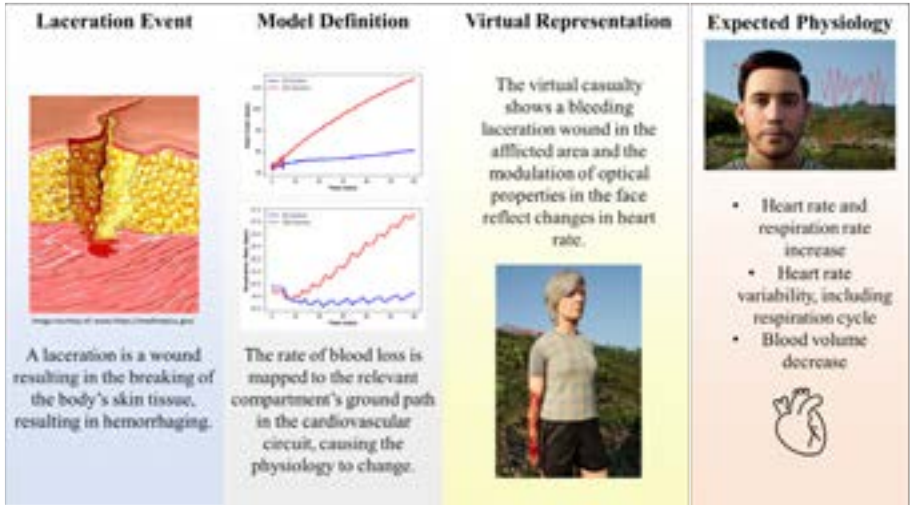
Metahumans

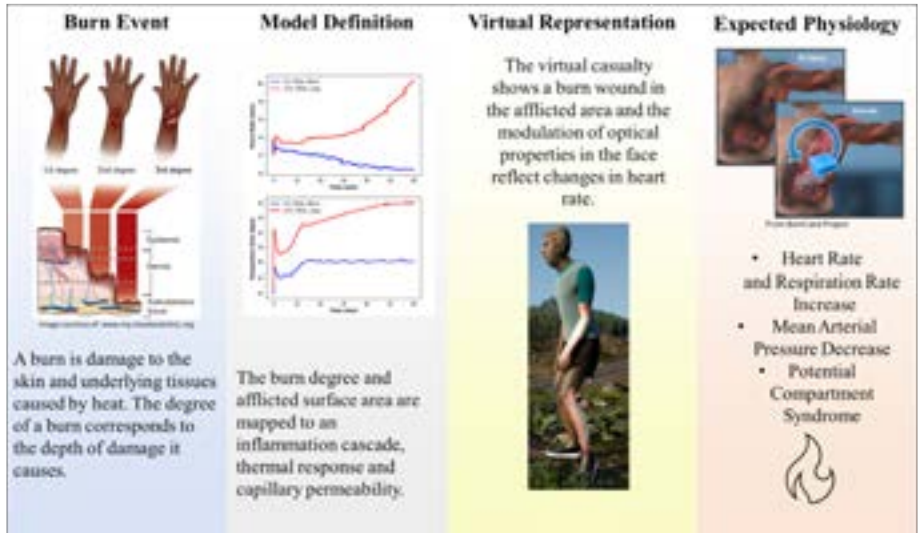
Variety of metahumans of different age, sex, body type, skin-tone

Available Sensor Feeds
IMU
GPS
LIDAR
RADAR
CAMERA
IR
Depth Camera

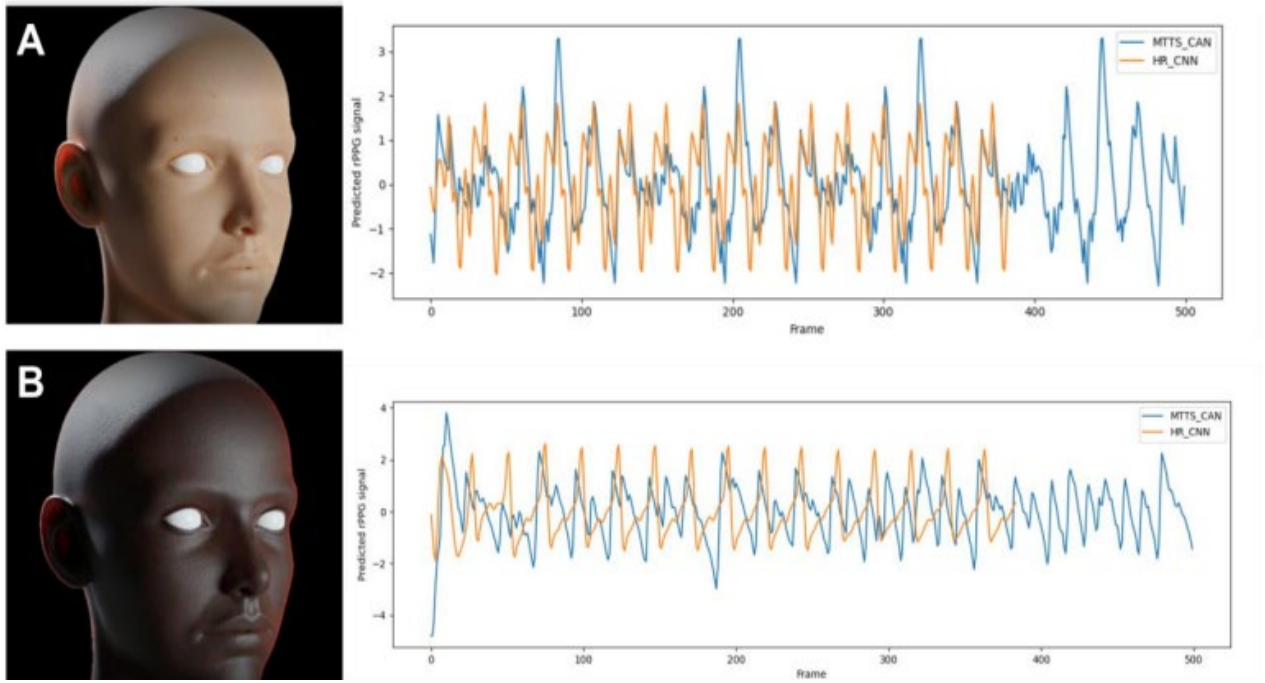
Virtual Platform – Injury examples and validation

Injury modeling





rPPG signals and heart rate predicted for avatars with different skin tones



DARPA BTO Live Chain

BIOLOGICAL TECHNOLOGIES OFFICE

BTO Livechain website

Programs

- **ABC**: Seeks to develop safe, battlefield-ready anesthetics in order to reduce injury-associated trauma and improve combat casualty outcomes
- **ALIAS:** Envisions a tailorable, drop-in, removable kit that would promote the addition of high levels of automation into existing aircraft, enabling operation with reduced onboard crew
- **DARPA Triage Challenge: Drives innovations in identifying vital signs of injury, locating and assessing casualties, and transmitting critical data**
- **FSHARP:** Will develop a deployable, shelf-stable, universal whole blood substitute as a hemorrhage countermeasure to sustain injured warfighters in austere, pre-hospital settings
- **GOLDEVAC:** Will yield a single intravascular device and gas exchange (i.e. oxygenation) strategy to address a wide range of life-threatening injuries and buy more time to accomplish medical evacuation
- **In the Moment:** Investigates whether the alignment of artificial intelligence (AI) to individual humans affects willingness to delegate in high-stakes domains
- **Medics Autonomously Stopping Hemorrhage (MASH):** Aims to develop robotic systems to autonomously find and stop life-threatening bleeding inside the body, giving injured warfighters a much better chance of survival in combat situations
- **RACER:** Will demonstrate game-changing autonomous UGV mobility, focused on speed and resiliency, using a combination of simulation and advanced platforms

See you at the Finals!

November 11 – Public Day

November 12 – DV Day

November 13 – Championship webstream

Resources

[Challenge Event 2 highlights]

Upcoming dates

June 28, 2026	Team Qualification
November 11, 2026	Public Day
November 12, 2026	Distinguished Visitors Day

[Medic POV 360 video]

Challenge Documents

- Qualification guide
- Rules document
- Operations guide

www.darpa.mil

https://www.darpa.mil/research/challenges/darpa-triage-challenge
triagechallenge@darpa.mil