
# DARPA TRIAGE CHALLENGE

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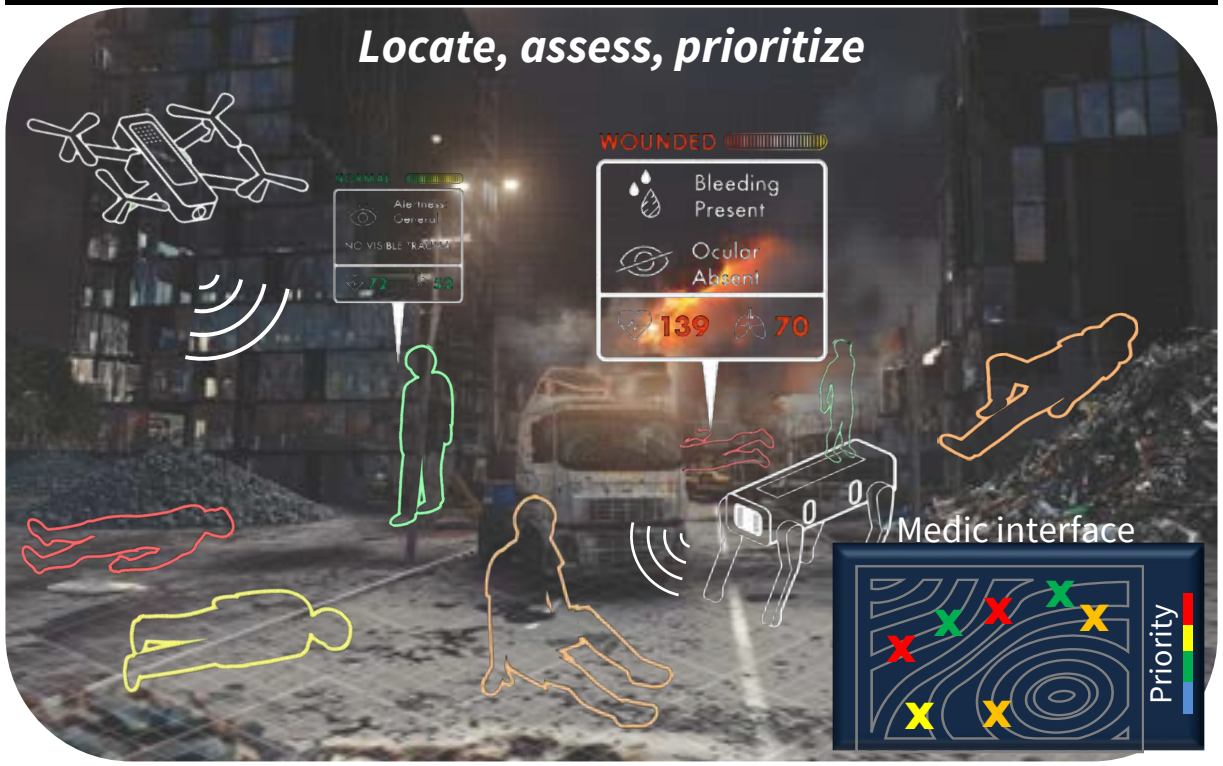
DARPA TRIAGE CHALLENGE

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

# DARPA Triage Challenge

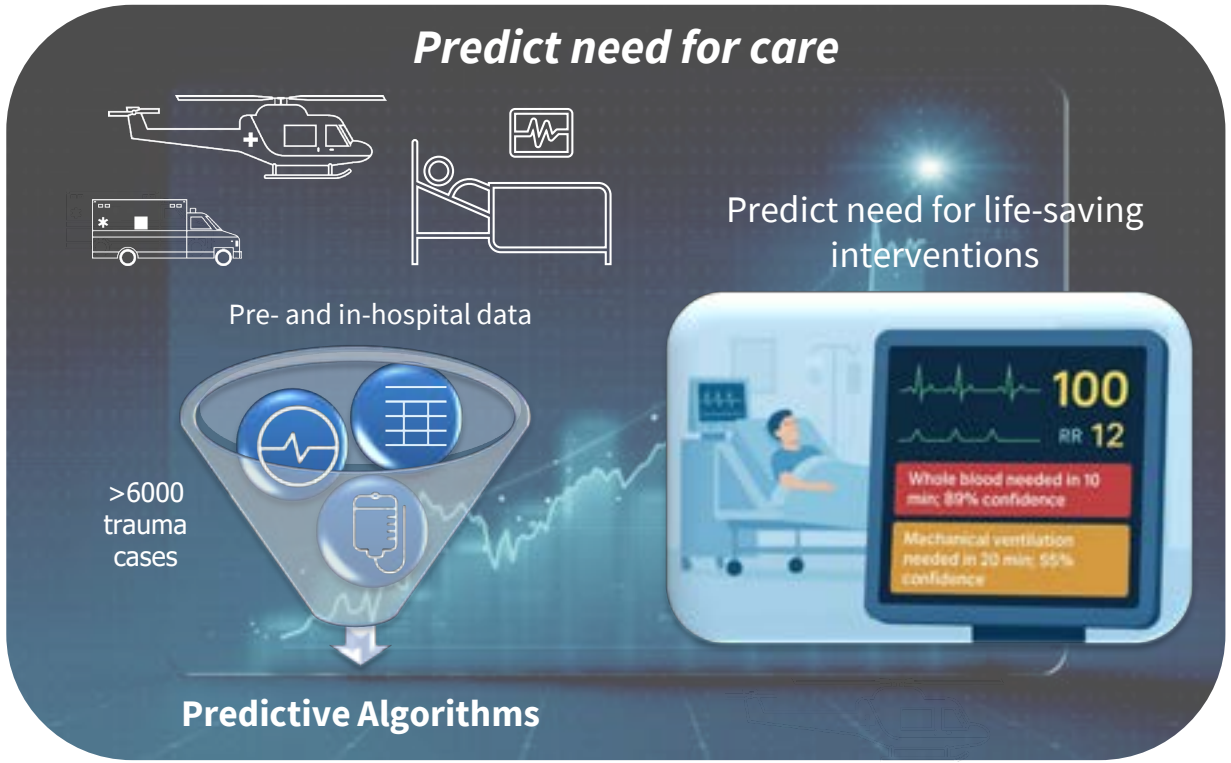
DoD Problem: Current triage approaches are inadequate for mass casualty incidents and have limited value for predicting need for life-saving medical interventions.

## 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

Respiration rate RR

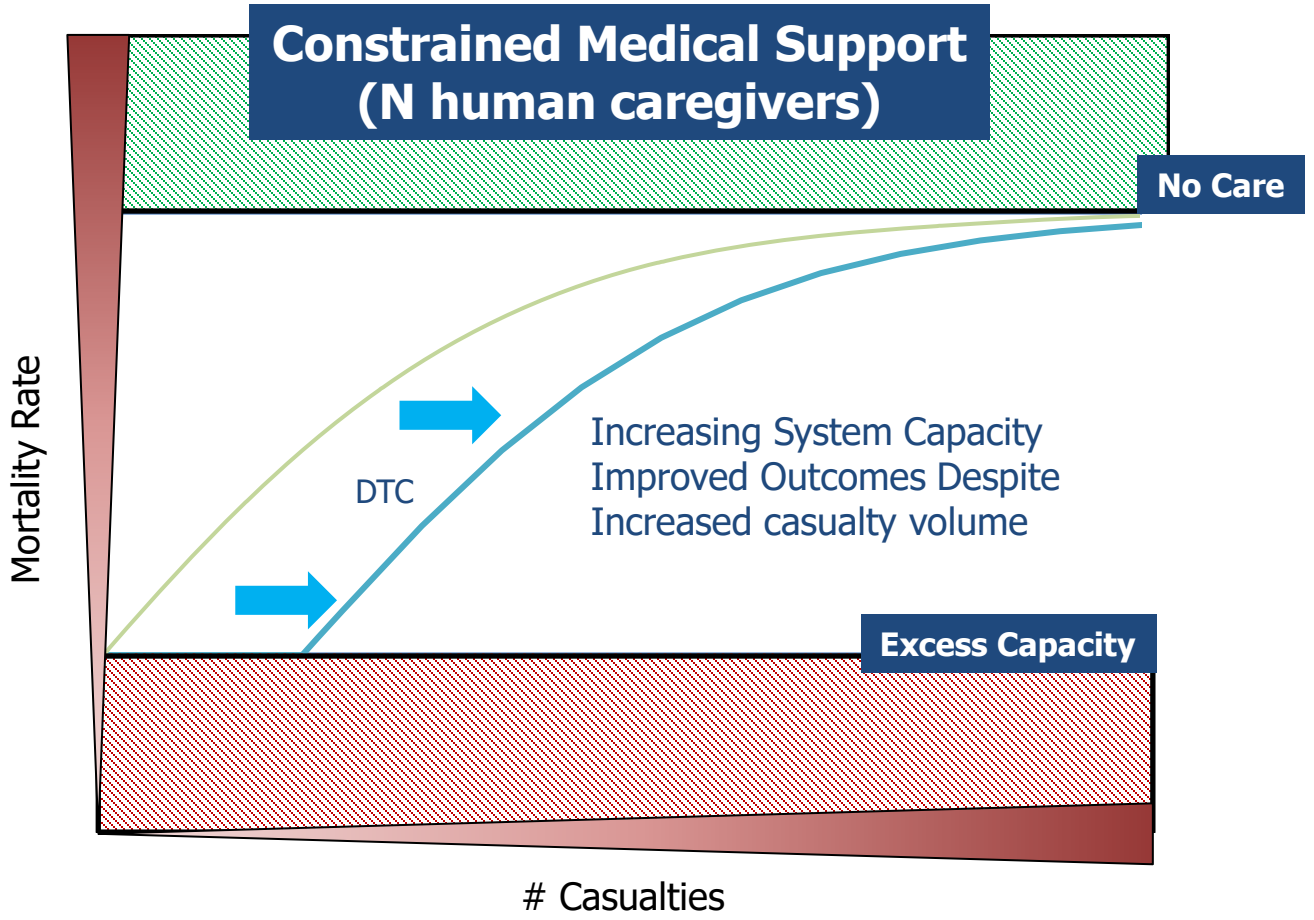
# DTC solves performance problems across the pre-hospital triage timeline

| 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

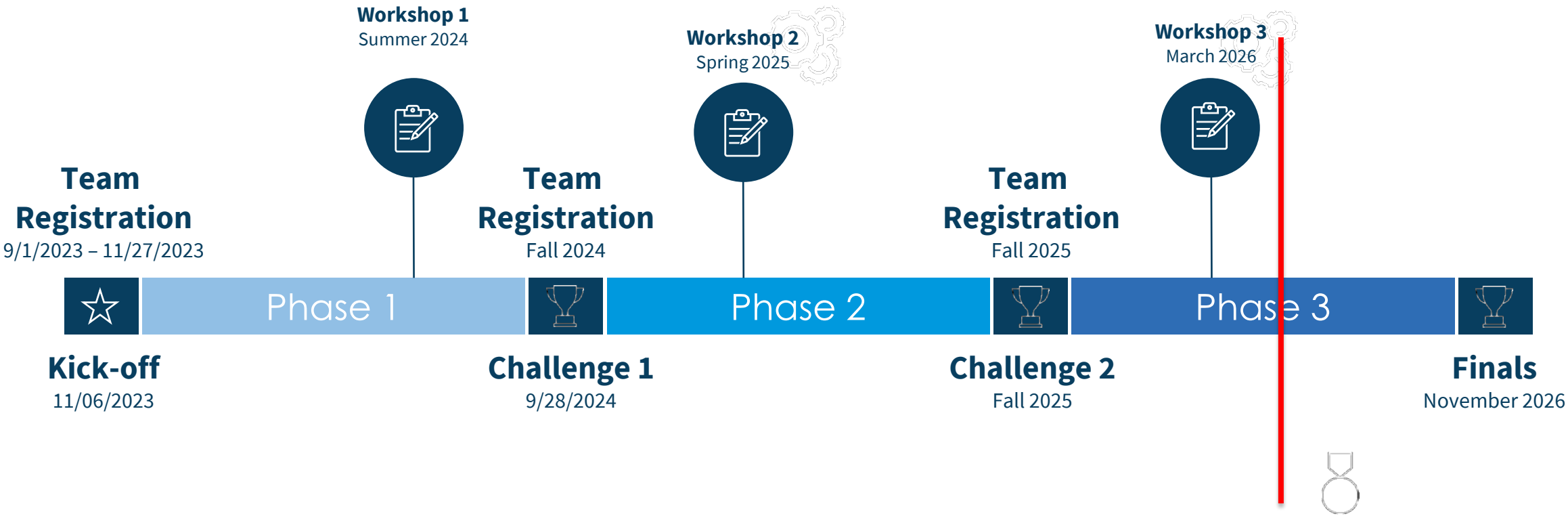
- Makes finding casualties faster
- Prioritizes care faster
- Medics can plan more efficiently

**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 |

**Finals**
**Fall 2026**

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

†All teams
*Self-funded teams only

# Systems Competition – Increasing difficulty

Guardian Centers, GA

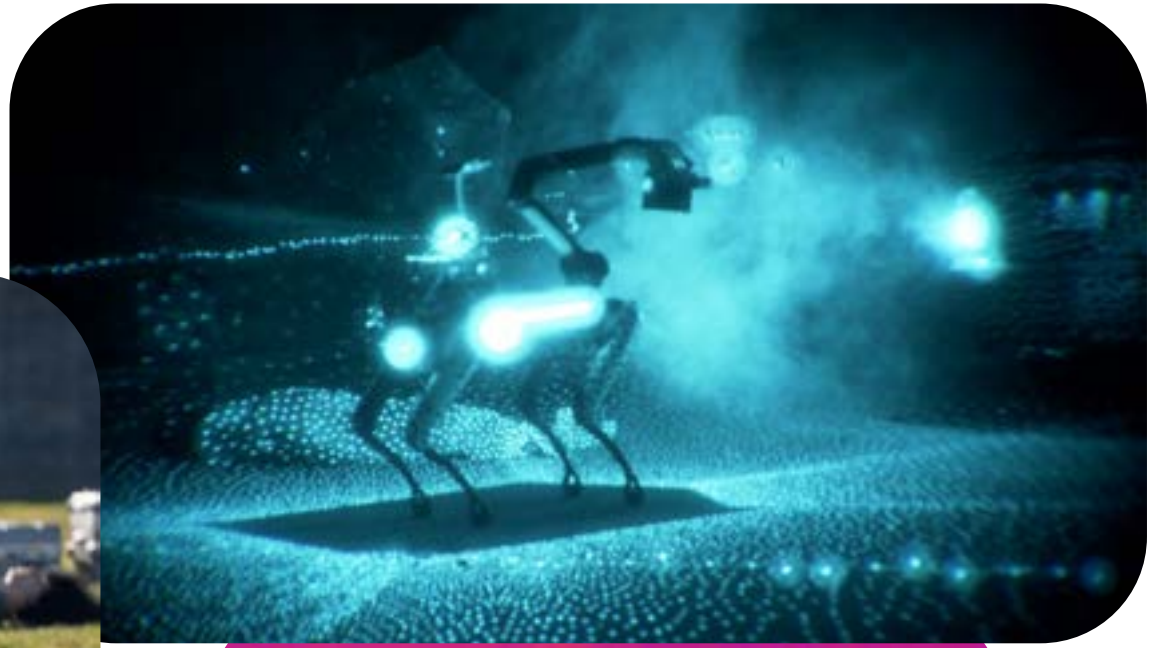
Disaster City, TX

| 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.<br>• Daylight with good visibility<br>• Fiduciary support for localization | • Navigation through grass, mud, asphalt, ash, etc.<br>• Nighttime / low light<br>• Smoke / dust / fire pit<br>• No fiduciaries for localization | • Navigation through grass, mud, asphalt, ash, etc.<br>• Multi-level structure, large rubble pile<br>• Large variations in lighting<br>• Smoke / dust / fire pit |
| Casualty Placement and Presentation | • Casualties respond to verbal prompts<br>• Well-separated casualties<br>• Casualties are stationary<br>• No change in physiology during scenario<br>• Casualties protected under mesh shelters | • Casualties respond to verbal prompts<br>• Co-located casualties<br>• Walking wounded with movement perimeter<br>• Realistic physiological decline/improvement during scenario | • Casualties respond to verbal prompts<br>• Co-located casualties<br>• Realistic physiological decline/improvement<br>• **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

# Year 2 courses

[DARPA Triage Challenge Workshop 2]



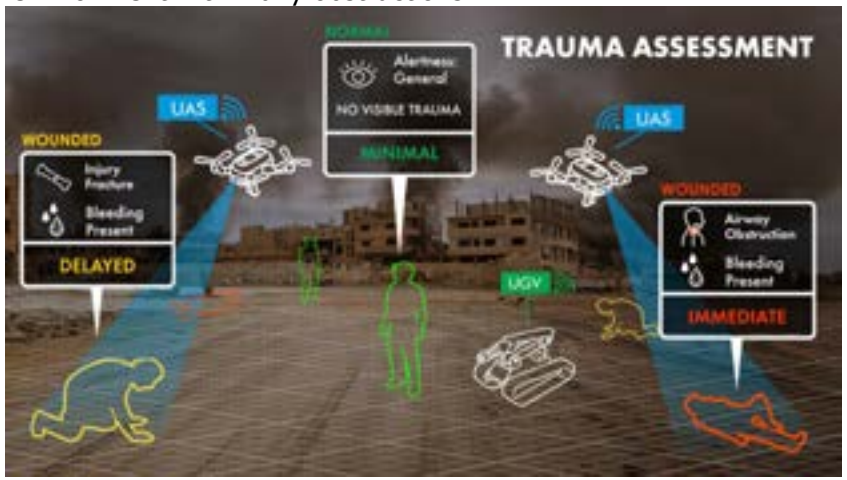
Guardian Centers, GA

# Workshop 3 Courses

Guardian Centers, GA

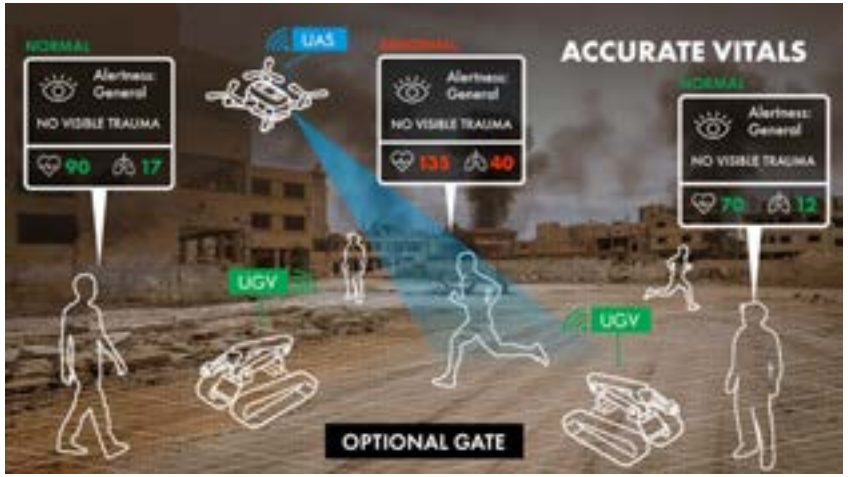
# Courses – Component testing gates


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.

Uncrewed aircraft system UAS; Uncrewed ground vehicle UGV

# 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

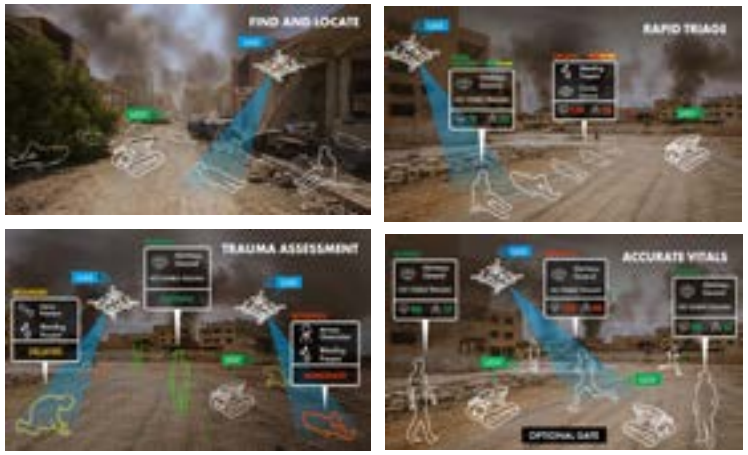
Grand Prize
$1,500,000

**Human-machine Teaming**

4 Teams

**Championship**

2 Teams

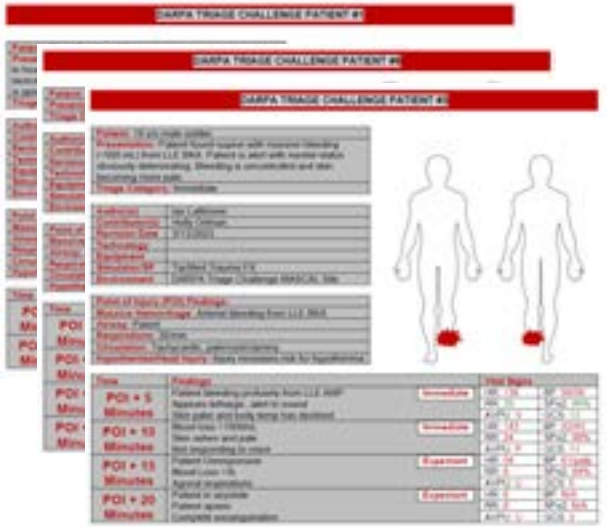



# Mass casualty MEDSIM at scale

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

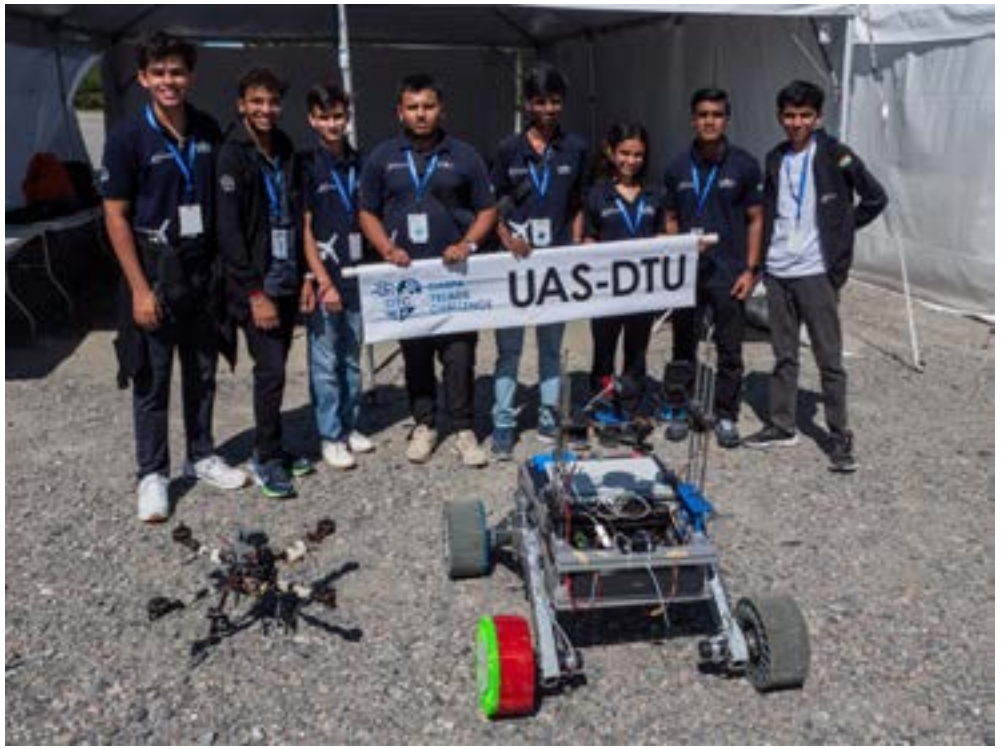

Overhead view of the course
Each casualty is identified by their number

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

MEDSIM medical simulation; Naval Information Warfare Center NIWC; Independent verification and validation IV&V

# Systems competition teams


A maximum of 12 teams will compete at the Finals



# Systems teams strategies

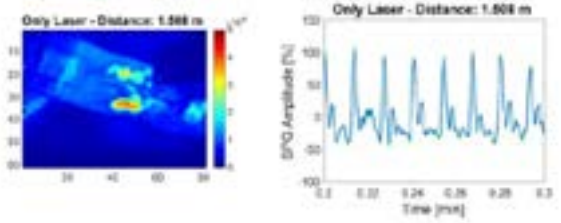
- UAS-only, UGV-only, mixed platforms
- Verbal prompts and audio capture, analysis using LLMs
- Machine-vision based person, pose detection (YOLO)
- Heart rate and respiration rate measured by minute change in color (RGB cameras) or movement (IR/RGB cameras, radar)

EO cameras

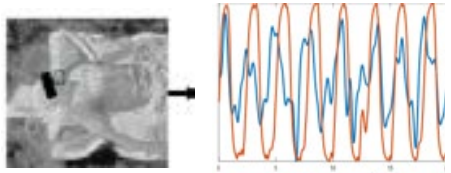
Verbal interaction with casualties with microphone and speakers

Radar detection, evaluation of casualties

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




IR detection of respiration



You only look once object recognition model YOLO; Red-green-blue RGB; Infrared IR; Electro-optical EO

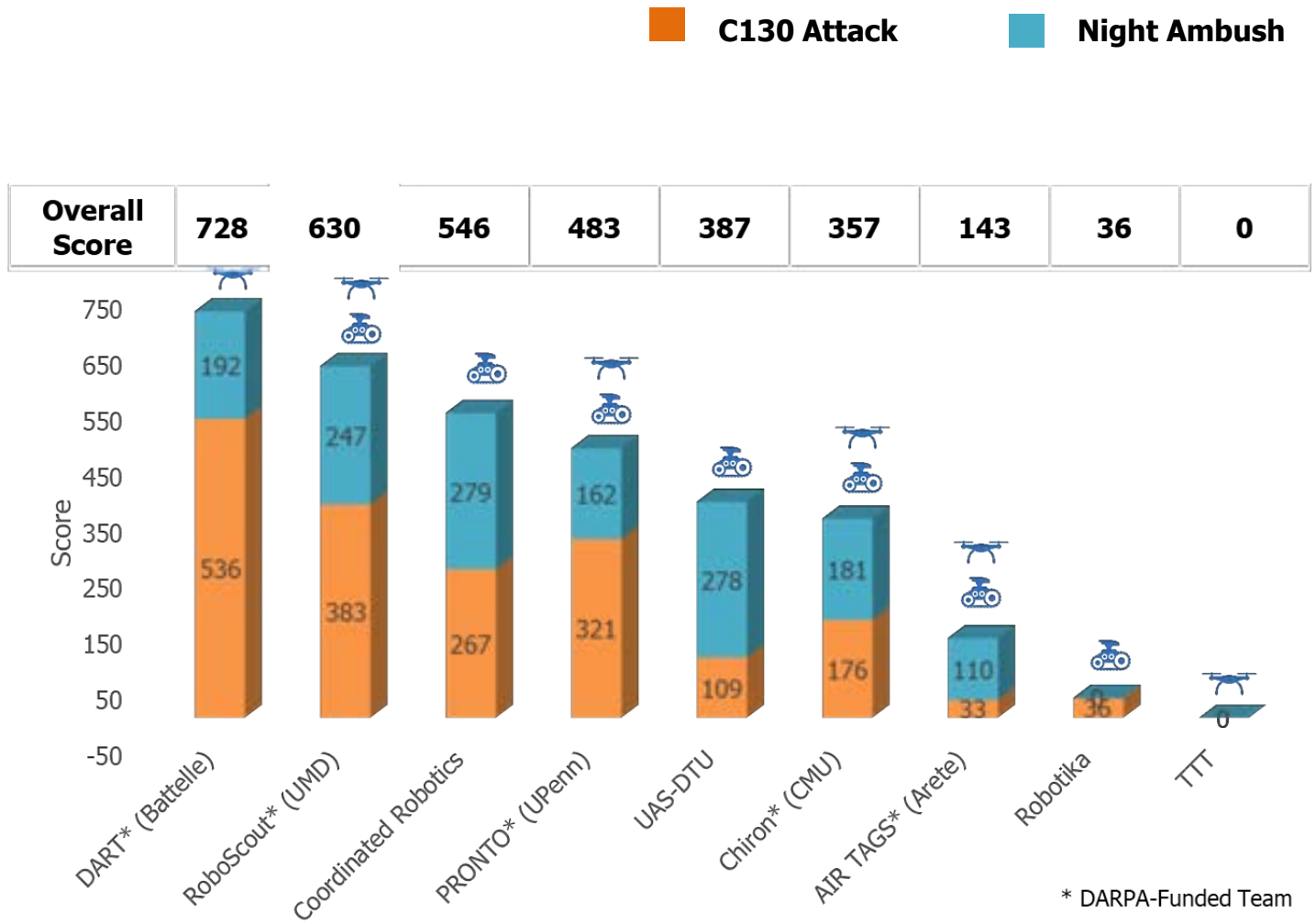
# Systems Competition Year 2 leaderboard

## Scoring Criteria

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

Bonus points given for speed

[More information]

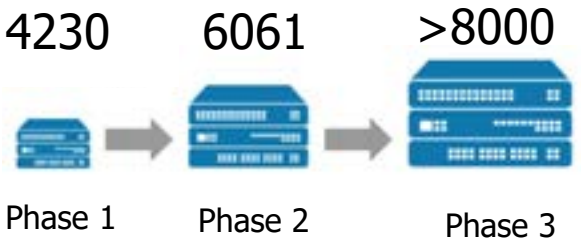



Heart rate HR; Extremity Ext; Not testable NT

# Data Competition – Predicting need for care

Pre- and in-hospital vitals data


Clinical Case Count




**Tasks**

- Predict need for life-saving interventions (LSIs) 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

Electronic health record 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

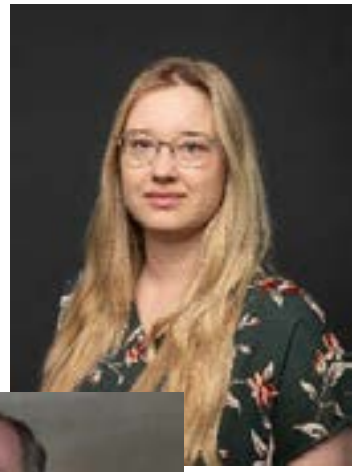
UPMC University of Pittsburgh Medical Center

# Data Competition teams and approaches

Maximum of 15 Teams will compete in the Finals

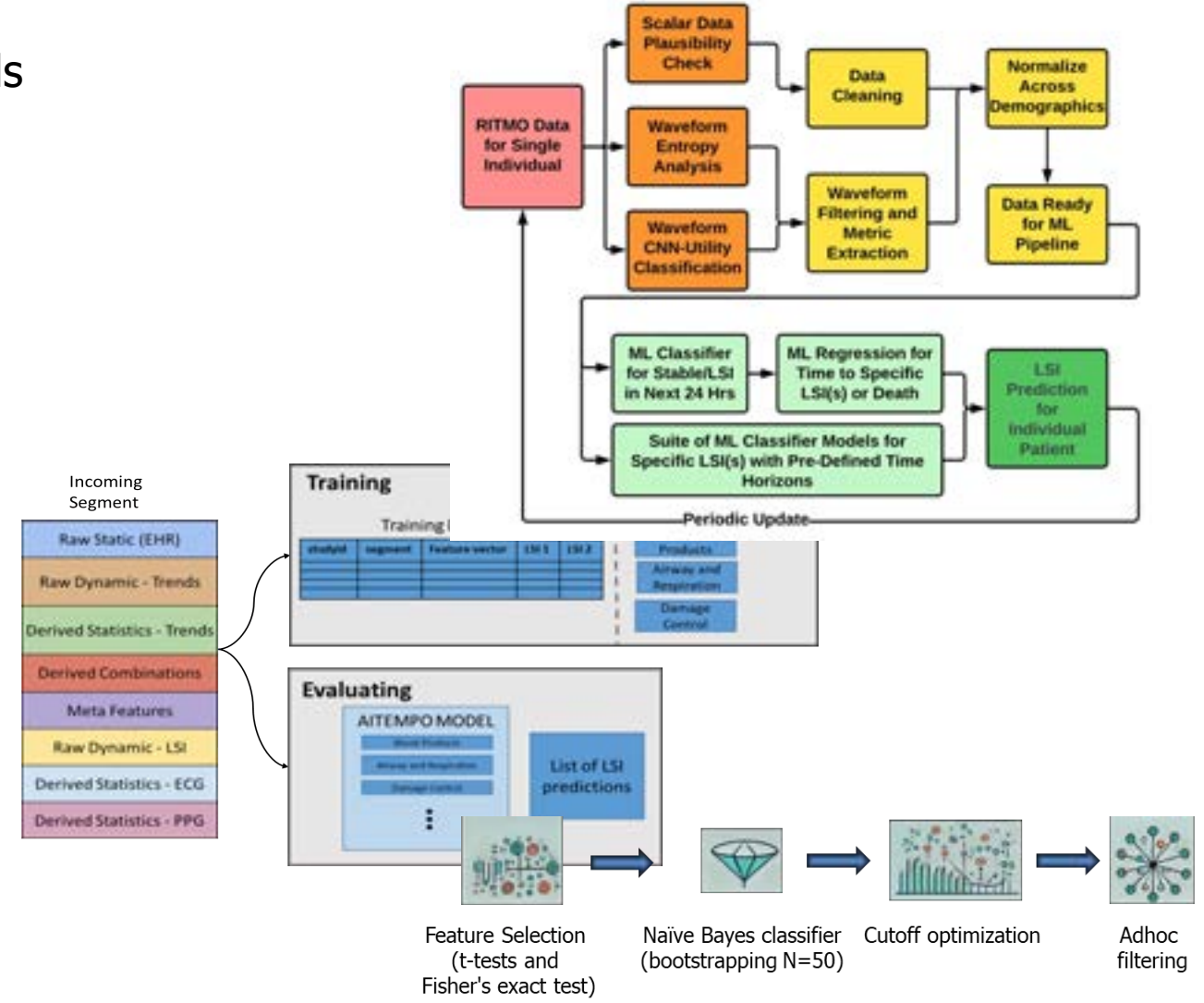
Triage360

Michigan Tech University



MarvsAI

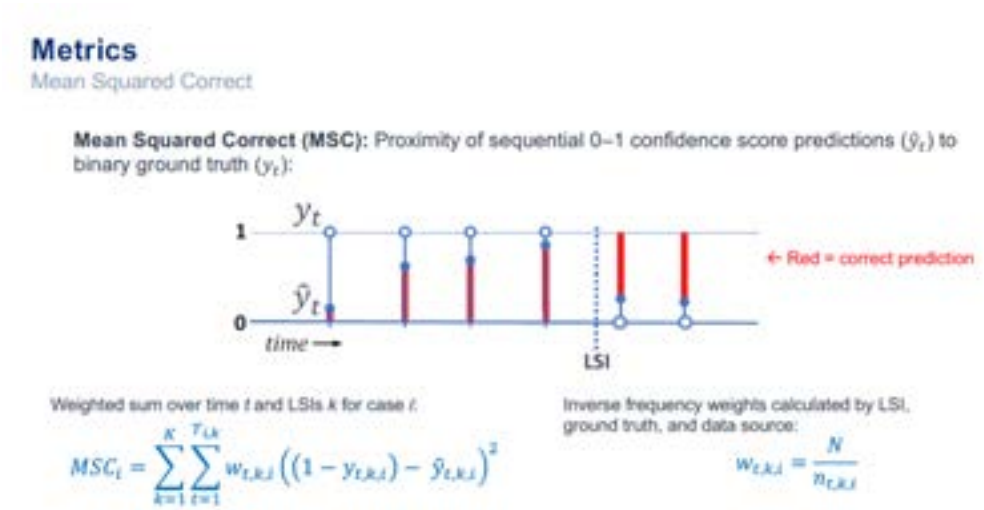
Coordinated Robotics



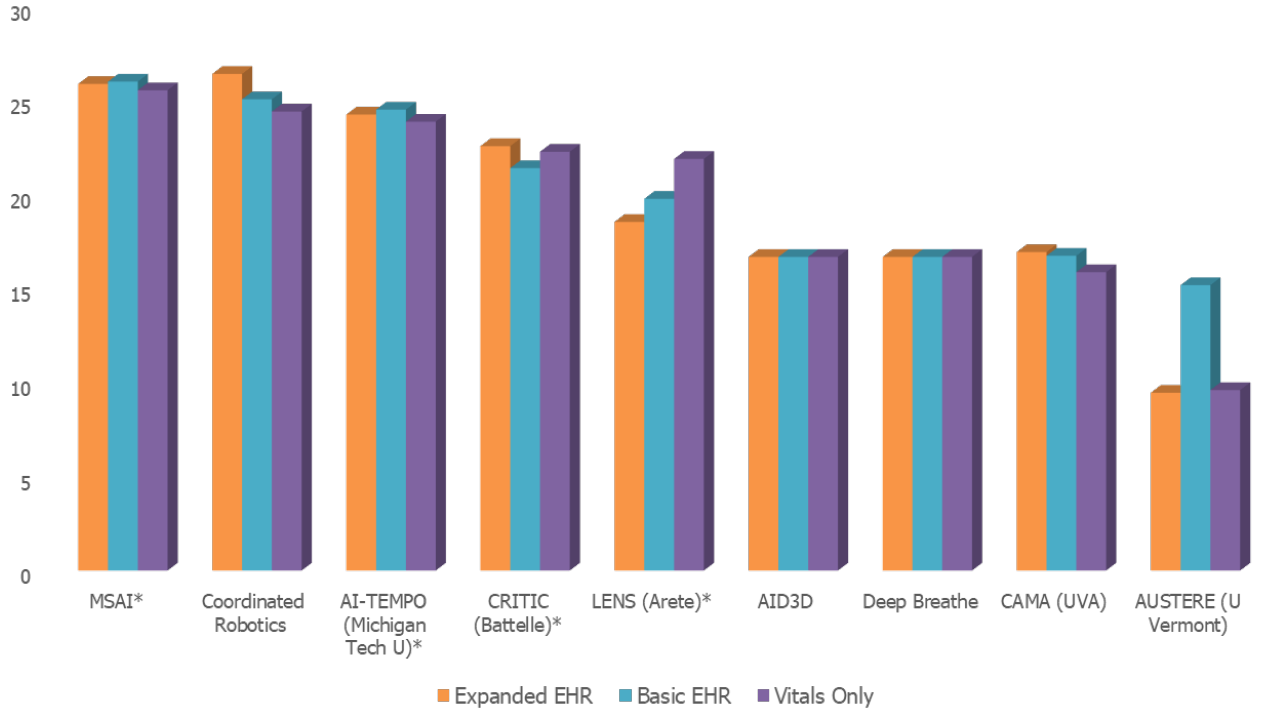
# Data Competition Year 2 leaderboard

## 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

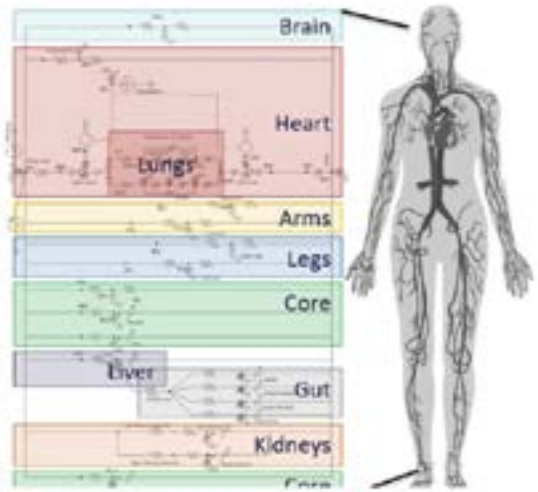
**Virtual Causality Representation**
Sensor detectable signals

**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**

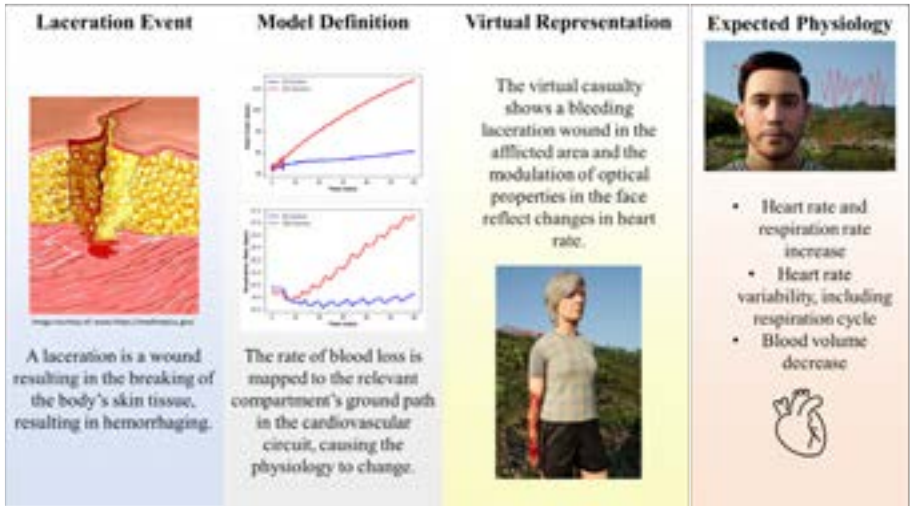
**Metahumans**

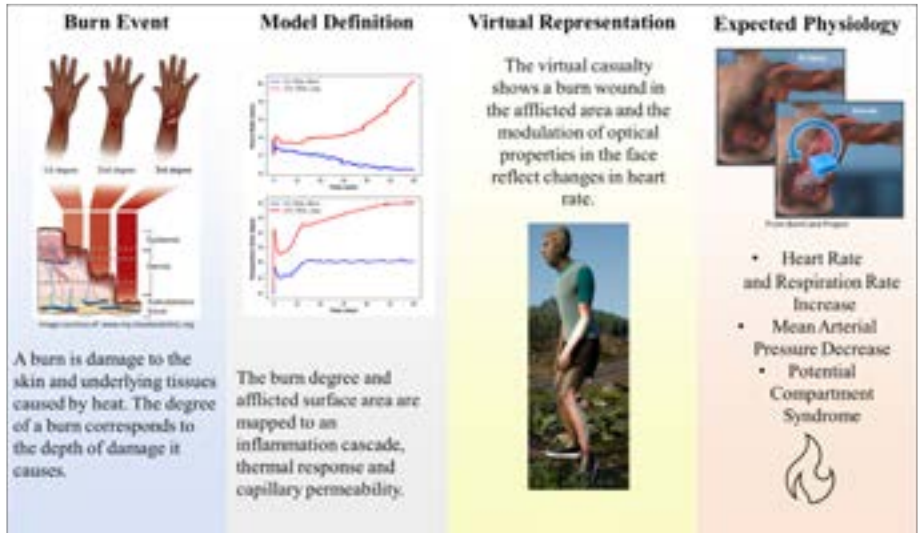
Variety of metahumans of different age, sex, body type, skin-tone

| Available Sensor Feeds |
|---|
| IMU |
| GPS |
| LIDAR |
| RADAR |
| CAMERA |
| IR |
| Depth Camera |

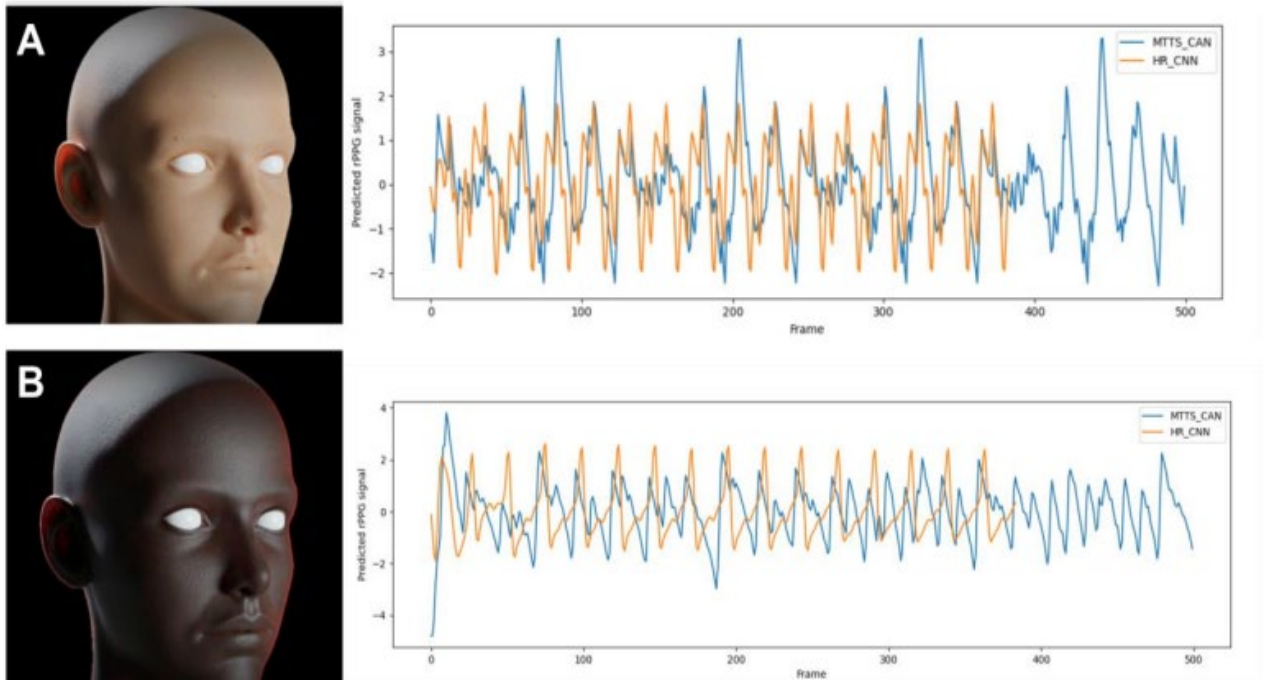
# Virtual platform – Injury examples and validation

## Injury modeling




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




Remote photoplethysmography rPPG

# 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!

DARPA TRIAGE CHALLENGE

## Upcoming dates

| | |
|---|---|
| June 28, 2026 | Team qualification close |
| November 11, 2026 | Public Day |
| November 12, 2026 | Distinguished Visitors Day |
| November 13, 2026 | Championship webstream |

# Resources

[Challenge Event 2 highlights]


[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