Virtual Reality Simulation for Assessment of Hemorrhage Control and SALT Triage Accuracy in First Responders

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Objective

- Hemorrhage control, triage efficiency, and triage accuracy are essential skills for optimal outcomes in mass casualty incidents.
- This study evaluated user application of skills through a Virtual Reality (VR) simulation of a subway bombing.

First *VR*esponder Simulation

- We developed an interactive, fully immersive and automated VR simulation using Unity for Oculus Quest 2 headsets.
- 11 patients were designed from a universal avatar and can be customized for injury type.
  - Life-threatening injuries: acute arterial bleed, penetrating injury, pneumothorax, and amputations.
  - Non life-threatening injuries: lacerations, sprains, hysteria, and confusion.
- Participants were placed in a customizable mass casualty incident (MCI) setting designed to resemble a bombed subway platform. Based on their level of training, trainees must navigate the scene to triage a varied number of injured patients.

First *VR*esponder Simulation

Top Right: Mixed reality photo of a first responder in the simulation
Top Left: Triage kit contents
Bottom: Customizable subway platform simulation layout

The Universal Patient

The Universal Patient

Thigh Laceration | Shin Amputation | Pneumothorax | Arm Laceration
Shrapnel | Head Wound | Puncture Wound | Multiple Injuries

The Universal Patient can be customized with a variety of life-threatening and non life-threatening injuries.

Learn more about the *VR*esponder training
https://go.osu.edu/mcivr_video

Methods

- 389 EMS clinicians and healthcare professionals engaged in a VR simulation.
- First *VR*esponder, is a high-fidelity, fully immersive, automated, customizable, and programmable VR simulation platform.
- Participants were assessed on:
  - Skill in using the Sort-Assess-Life saving Interventions-Transport (SALT) triage protocol.
  - Effectiveness of their communication with patients.
  - Skill in applying appropriate life-saving treatments.
- Metrics including time to control life-threatening hemorrhage and triage efficacy were analyzed using median and interquartile ranges (IQR).

SALT Protocol
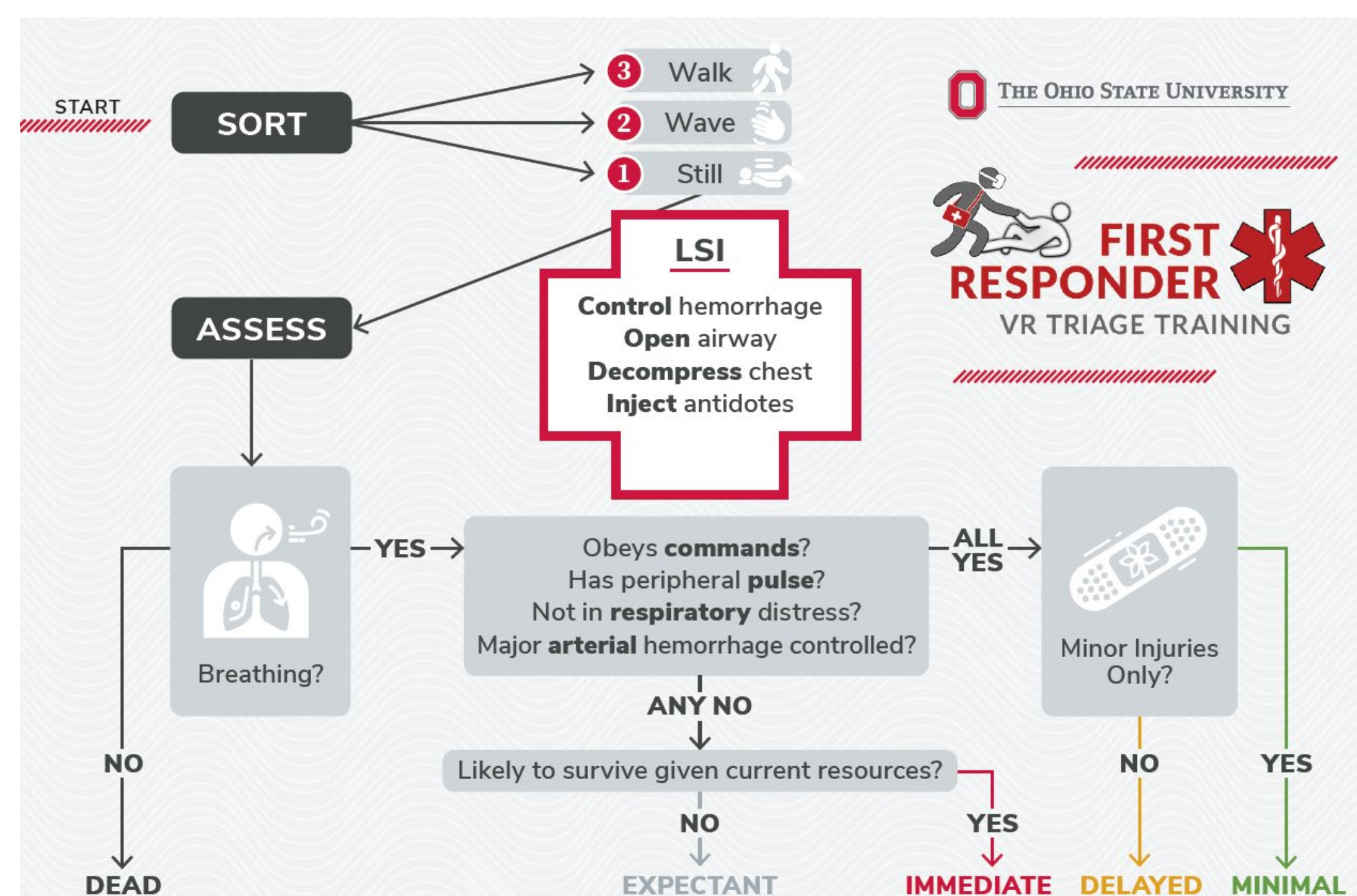
Simulation Performance Report

Results

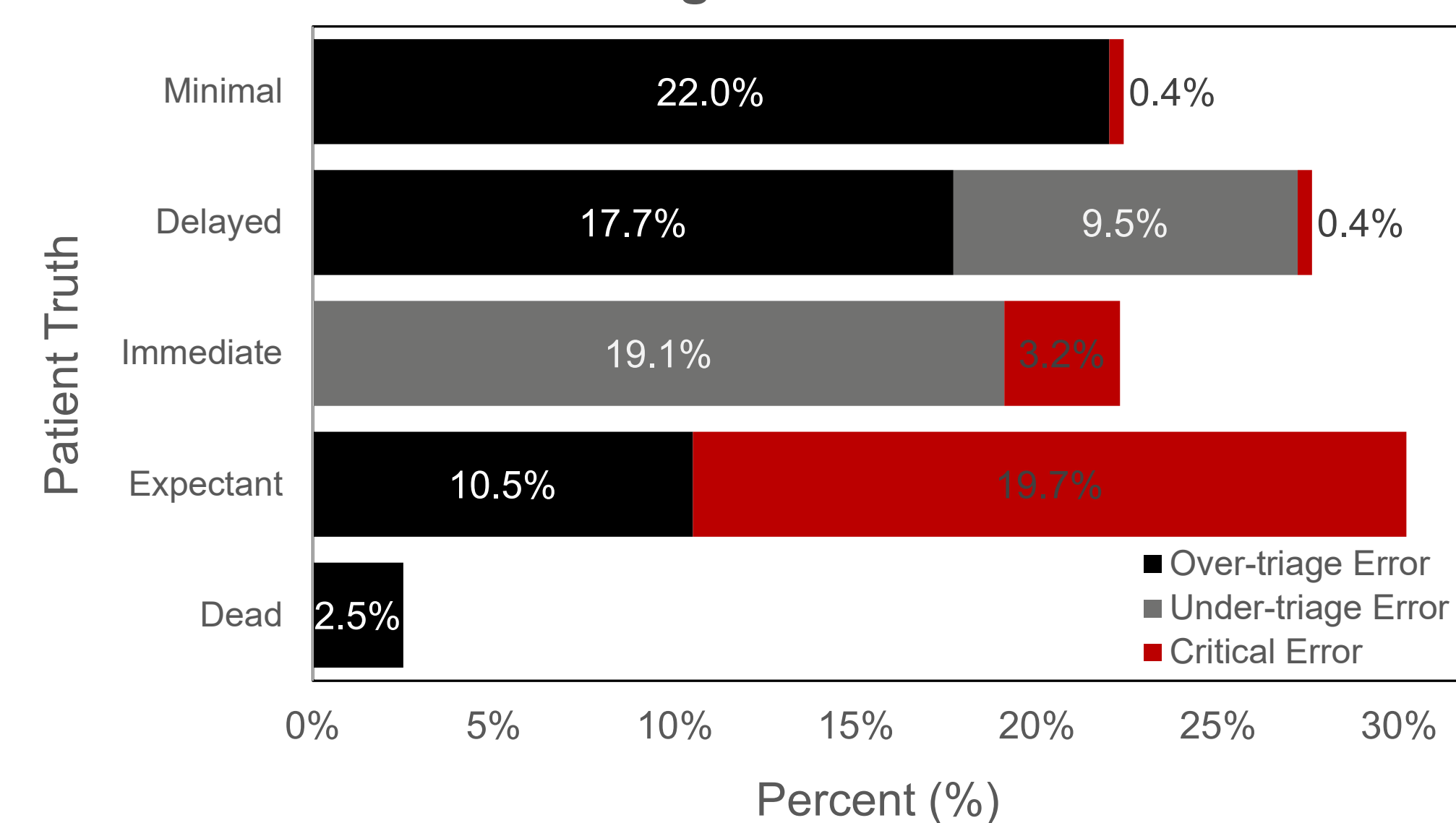| Measure	Median Time (SD)	25th percentile	75th percentile
Time to triage scene	7:38 (2:27)	6:13	8:59
Time to hemorrhage control for all life-threatening bleeding Implemented by 93% of participants	4:54 (1:48)	3:57	6:08
Time to hemorrhage control per patient	0:14 (0:28)	0:09	0:23
Values in minutes			

Results *(continued)*

Triage Accuracy
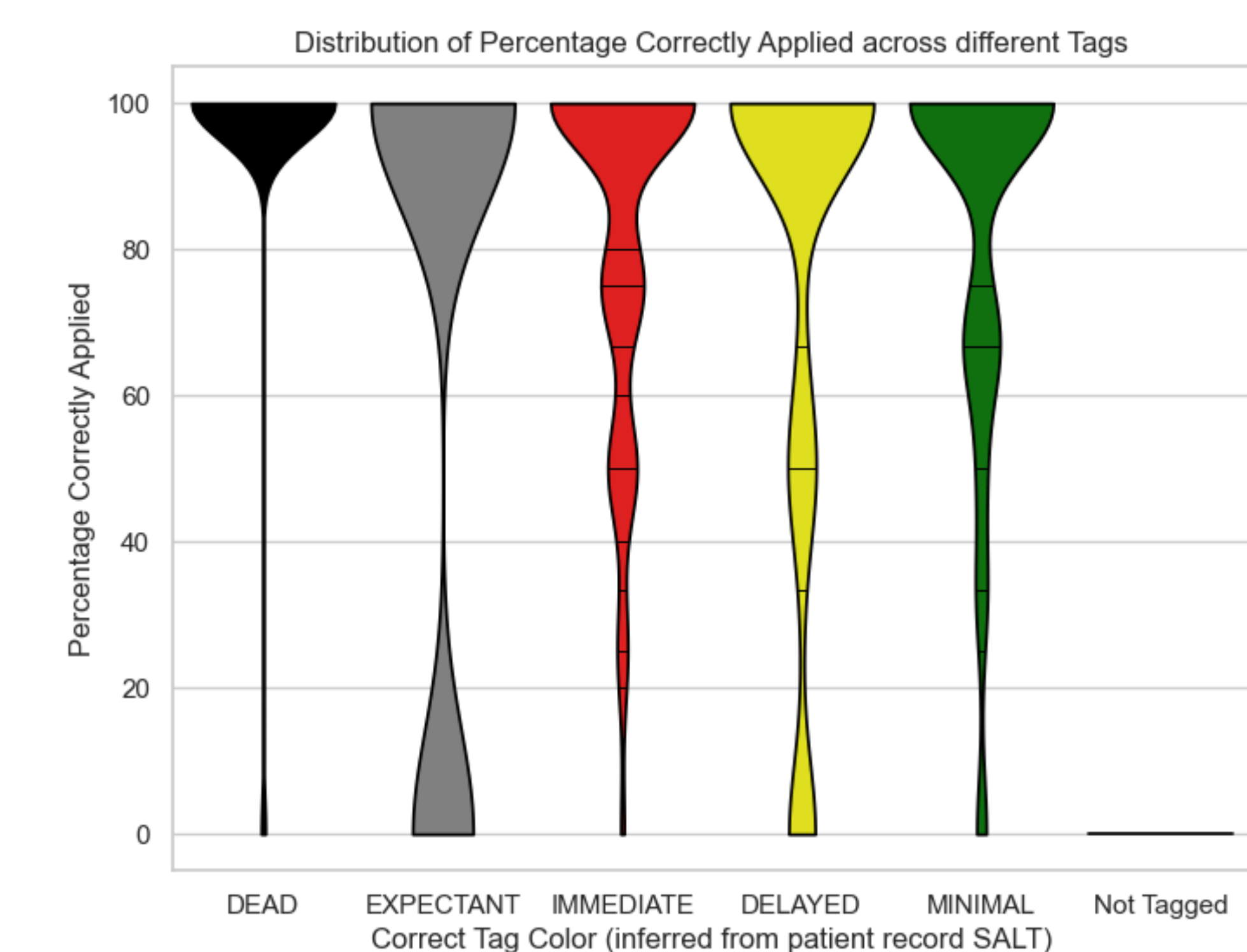
- Through their sorting process, 16% of participants consistently evaluated patients appropriately in this order: still, able to wave, and able to walk.
- Participants accurately tagged 73% of patients.

Conclusions

- The First *VR*esponder simulation, currently under validation, is an immersive way to teach and assess hemorrhage control and triage ability.
- The simulation aims to enhance realism by incorporating distractors and refining assessment tools.

Future Directions

- Future goals are to enhance in-simulation experience with addition of common distractors and to optimize assessment tools.
- We are comparing these metrics for different groups of medical personnel including medical students, residents, EMTs, etc.
- We are developing novel metrics to characterize triage efficiency. Below is an example of one responder's movement map through the scene.

Responder Patient-to-Patient Movement In Scene
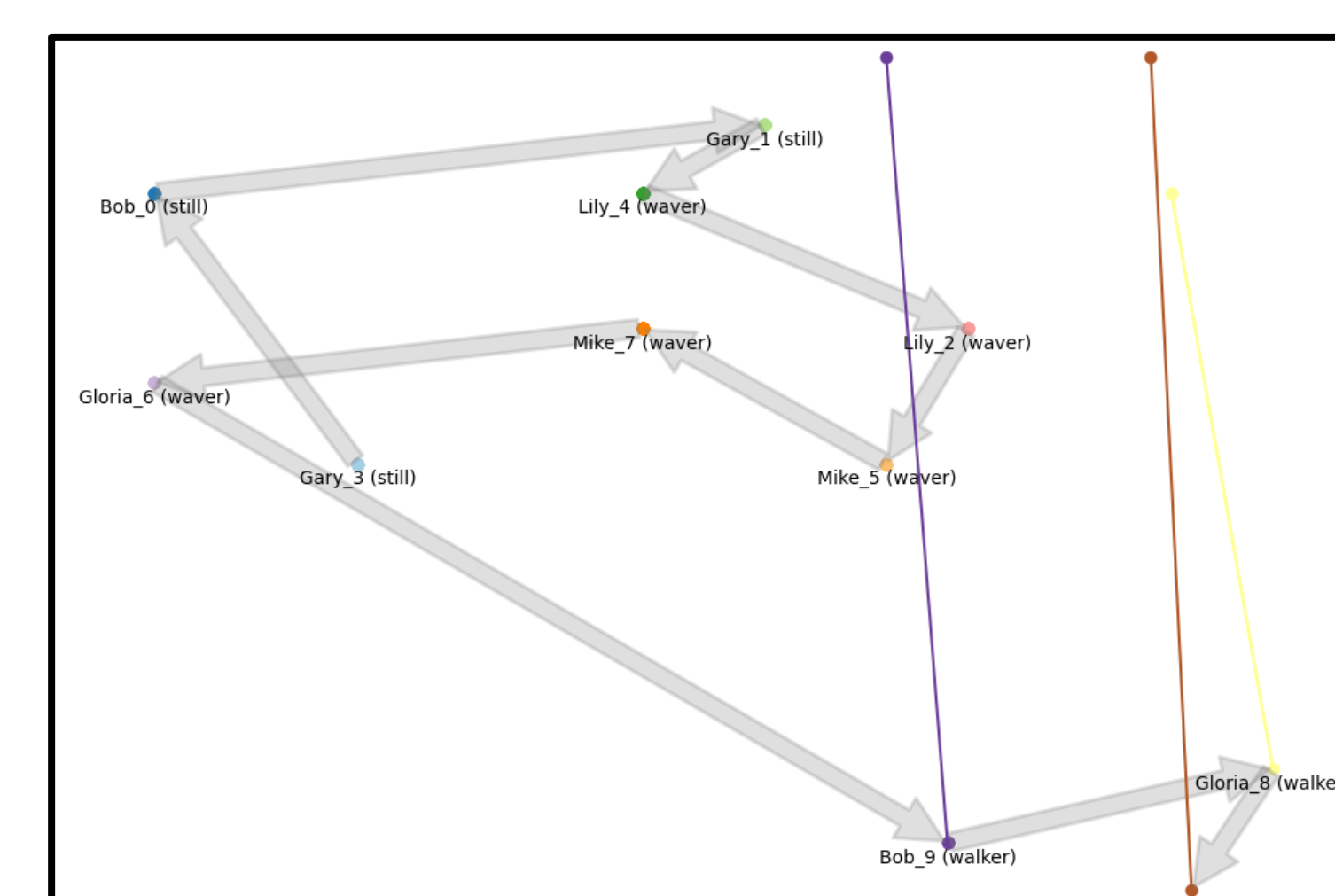
- We will be using an adaptation of the First *VR*esponder simulation to explore decision making in military triage scenarios for the DARPA In the Moment program.