



# Training Effectiveness for Point of Injury Medical Care – Vital Sign Monitoring and Demographic Comparisons of Paramedics in Warm Zone Active Shooter Drills

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## Background

Terrorism and mass shootings in the United States have shifted first responder tactics to providing care in "warm zones" – areas potentially under threat – so victims may receive expedited treatment. Eighteen high-fidelity mass casualty active-shooter drills hosted by South Metro Fire Rescue were carried out in November 2018. They were designed as hyper-realistic immersion sessions to increase responder preparedness for handling stressful situations. The goal was to "inoculate" responders to the ill effects of stress.

## Objectives

Support and optimize high-fidelity trainings by determining if:

- Ultra-realistic simulation will trigger true-to-life stress responses
- Demographic factors (age; previous military, paramedic or mass-casualty training experience) will reduce an individual's stress response

## Methods

A wireless Caretaker 4 device was placed on the non-dominant wrist and finger of paramedics to measure heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP). De-identified demographic information was collected that included: age, years as a paramedic, previous mass casualty training experience and years of military service. Baseline vitals were established while the paramedics were seated and watching a training video. Direct monitoring and reporting were performed throughout the entirety of the event.

Event data was extrapolated from the time of dispatch to emergency department physician handoff. Seventeen paramedics (n=17) were followed caring for patients with life-threatening injuries. Systolic pressures above 220 and diastolic pressures above 120 were excluded from the dataset as artifact from the device measurement.

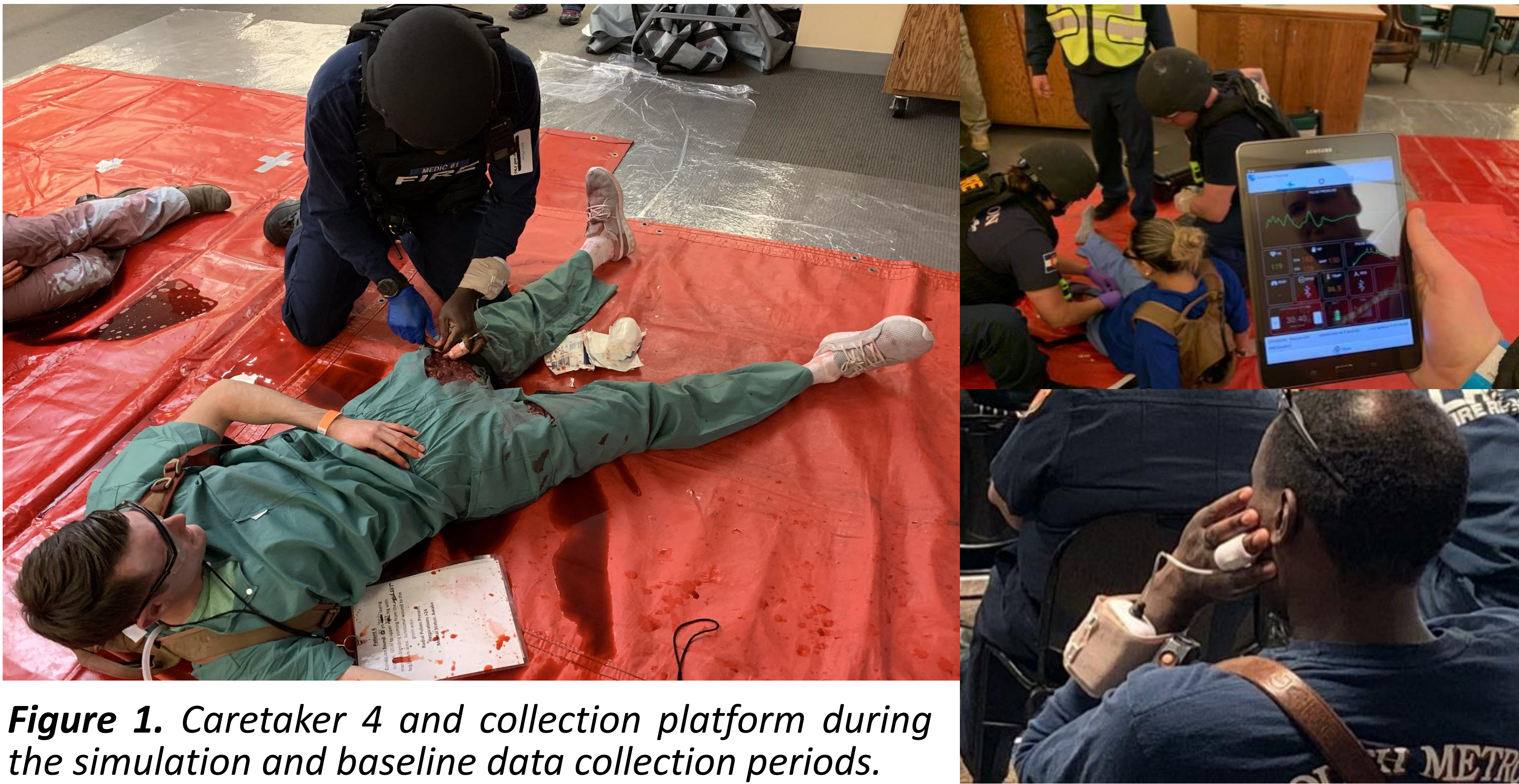


Figure 1. Caretaker 4 and collection platform during the simulation and baseline data collection periods.

## Findings

Measure	Absolute Difference (P-value)	Standard Deviation (P-value)
Systolic	+5.61 (0.04)	+9.55 (0.000)
Diastolic	+2.66 (0.052)	+7.12 (0.000)
Pulse Pressure	+3.17 (0.031)	+7.34 (0.000)
MAP	+8.78 (0.001)	+7.84 (0.000)
Heart Rate	+20.81 (0.000)	+5.68 (0.000)

Table 1. Baseline vital signs were compared to event vital signs. In every case, the average value increased significantly with the onset of the event and was maintained throughout its course. For each vital sign, the standard deviation increased dramatically, indicating great variation of significance. These were found using paired t-tests with normal residuals, thus indicating *the event produced a physiologic stress response amongst paramedics.*

Measure	Correlated Demographic	Demographic Value	R <sup>2</sup>	P-Value
Systolic	Military Experience	-3.42 per year	23%	0.047
Diastolic		-1.68 per year	23%	0.050
Pulse Pressure		-1.801 per year	24%	0.045
MAP		-3.90 per year	22%	0.057
Heart Rate	Previous Drills	+7.65 per drill		0.021
	Paramedic Experience	-1.67 per year	34%	0.082

Table 2. Years of previous military experience was correlated with mild significance to less variation of average blood pressures between the event and baseline readings. Thus, *previous military experience did reduce a paramedic's stress response.*

Prior participation in mass casualty trainings was found to increase each paramedic's average heart rate between baseline and the event. The correlation was mildly significant and indicates that *previous mass casualty trainings increased each paramedic's stress response.*

## Acknowledgements

Thank you to Caretaker for providing the Caretaker 4 devices, Strategic Operations for their Cut Suit Technology and South Metro Fire Rescue for their support and willing participation. A full paper is in press with the *Journal of Emergency Medical Services*.



Measure	Correlated Demographic	Demographic Value	R <sup>2</sup>	P-Value
Systolic	Military Experience	-2.05 per year	48%	0.007
Diastolic		-1.05 per year	51%	0.010
Pulse Pressure		-1.07 per year	48%	0.006
MAP		-1.67 per year	50%	0.003
Heart Rate	Previous Drills	+2.97 per drill		0.041
	Paramedic Experience	-1.309 per year	45%	0.043
	Age	+0.855 per year		0.102

Table 3. Variations in sample standard deviations across baseline and event data sets were found to correlate with demographic values. Years of previous military experience was correlated with moderate significance to a decrease in sample standard deviation in blood pressure. *Previous military experience decreased each paramedic's stress response.*

Years of previous paramedic experience was correlated with mild significance to a decrease in sample standard deviation in heart rate. This indicates that *previous experience as a paramedic dampened one's stress response.*

Sample standard deviation of heart rate correlated positively with age and participation in previous MCI drills. That being said, *age and previous participation in MCI trainings increased the stress response experienced by a paramedic.* All statistical analyses for demographic factors were found using General Linear Models with normally distributed residuals.

## Discussion

The vital sign data from simulated "warm zone" care was evaluated to determine if the trainings effectively produced a stress response and further, if there were correlations between level of stress experienced and paramedic demographics. **Results from our study support the value and habituation effect of hyper-realistic, hands-on, "warm zone" care, training sessions** for first responders and the military. Prehospital care should focus future efforts on further development of such scenarios utilizing high-fidelity simulators to best prepare for mass-casualty field care.

Our study also concluded that **previous military or paramedic experience is associated with a less dramatic stress response in a stressful environment** and that the number of mass casualty training events previously participated in increased paramedics' stress responses during the event. Further research on the effects of repeated simulation trainings on physiological stress markers may be warranted to explore the positive correlation between prior experience in ultra-realistic training drills and increased stress responses.