



Injuries of Concern & Medical Research Plan for Warrior Injury Assessment Manikin Project (WIAMan)

John G. Alvarez

PM, Joint Trauma Analysis and Prevention of Injury in Combat

DPM, UBB Manikin Project

U.S. Army Medical Research and Materiel Command

john.alvarez@us.army.mil

(301)-619-9470



NOTE
Nikki Brockhoff
Live Fire Test and Eval

OASD (HA)
CAPT David Street
Program Director
Advanced Development

- Funding Sponsor
- Program Manager HA funds

Dep Director, S&T
Mr. Randy Coates
RDECOM

WIAMan Project Director
LTC LaMont Hall
DASA R&T

Dep Director, Medical
COL John Alvarez
MRMC

- Manage and execute overall program
- Ensure Cost, Schedule and Performance objectives are met

USAARL

- Execute Medical Research Contracts
- Deliver Injury Assessment Reference Values (IARV's) to ATD Developer
- Define and prioritize injuries

Linking Back to LTC Hall's Brief

NSRDE C

TARDEC

ARL/SL AD

- Define loading environment, military environment
- Integrate Medical Research and ATD Development (anthropometry)
- Execute Development Contracts
- Integrate Instrumentation and FEM
- Test and validate ATD



Injuries of Concern



Linking Back to LTC
Hall's Brief

Approach:

- To overcome these shortcomings , an entirely new human accelerative loading measurement device and improved injury assessment methodologies will be developed. These devices and methodologies will be founded on:
 - Cadaveric research that defines human injury criteria for the under body blast environment (short duration, high magnitude, high rate, primarily in the vertical direction)
 - Physical parameters that are representative of the current soldier population
 - ***Full consideration of the military operational environment***
 - Instrumentation that satisfies the measurement and data acquisition requirements of the live-fire test and evaluation environment
 - ***Analyses of injury data gathered from operational experiences in Iraq and Afghanistan***
 - Relevant assessment methodologies that can be extended to yield injury assessments at higher fidelities and with higher confidence



Injuries of Concern

- Analysis done by JTAPIC Partnership with data from ARL-SLAD, Armed Forces Medical Examiner, Naval Health Research Center, Anti-Armor Analysis Program. Lead Analyst was Ms. Natalie Eberius (ARL-SLAD)
- Based on analysis of multiple blast injuries of concern to the military vehicle community
- Injuries coded using the Abbreviated Injury Scale (AIS)
- Total Casualties N=608, combination of WIA/KIA, Casualties with minor/superficial injuries excluded
- Wounded in Action (WIA) Casualties - N=456 with 1637 coded injuries
- Killed in Action (KIA) Casualties – N=152 with 2912 coded injuries



Injuries of Concern (continued)

- Number of Injuries
 - Wounded in Action (WIA) Casualties - 1637 injuries
 - 1054 (53%) are fractures
 - 188 (11%) are internal organ
 - 227 (14%) are concussions
 - Killed in Action (KIA) Casualties – 2912 Injuries
 - 1529 (53%) are fractures
 - 913 (31%) are internal organs
 - Dislocation, Sprain, Crushing, Burn, Nerve much smaller number of injuries, relative to total number of injuries cataloged



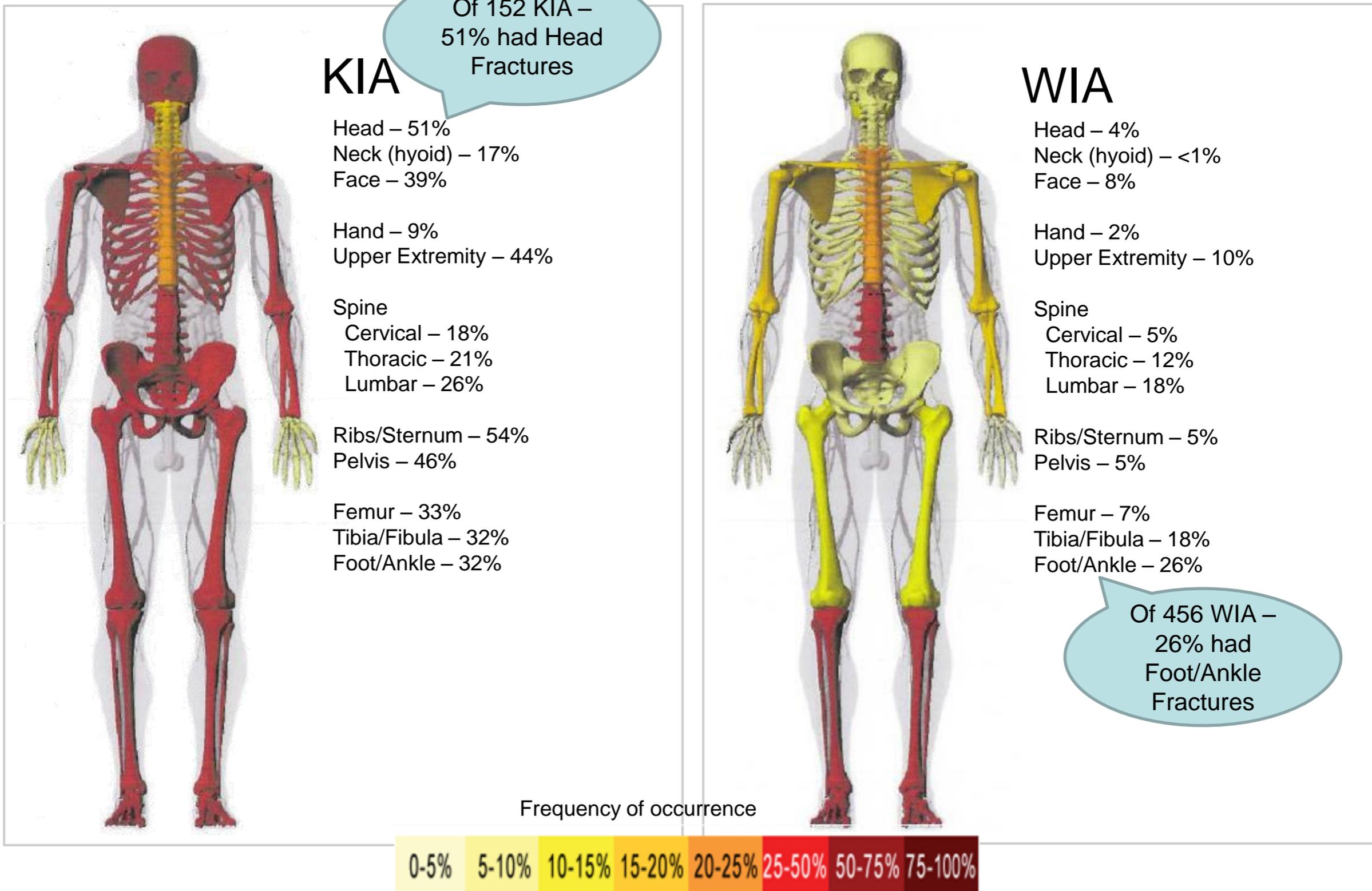
Injuries of Concern (continued)

- Percents of Warriors Injured
 - In greater than 50% of 456 WIA warriors we see fractures
 - Approximately 10% of 456 WIA warriors we see internal organ injury
 - Approximately 48% of 456 WIA warriors had concussion that was characterized by a brief period of unconsciousness
 - In greater than 80% of the 152 KIA warriors we see both fracture and internal organ injury
 - In greater than 20% of the 152 KIA warriors we also see Dislocation, Amputation, Blood Vessel, and Contusion injuries
 - In 11% of our 152 KIA warriors wounds were coded solely as “whole body (explosion-type) injury” which is defined as massive multiple organ injury to the brain, thorax and/or abdomen, with loss of one or more limbs and/or decapitation.



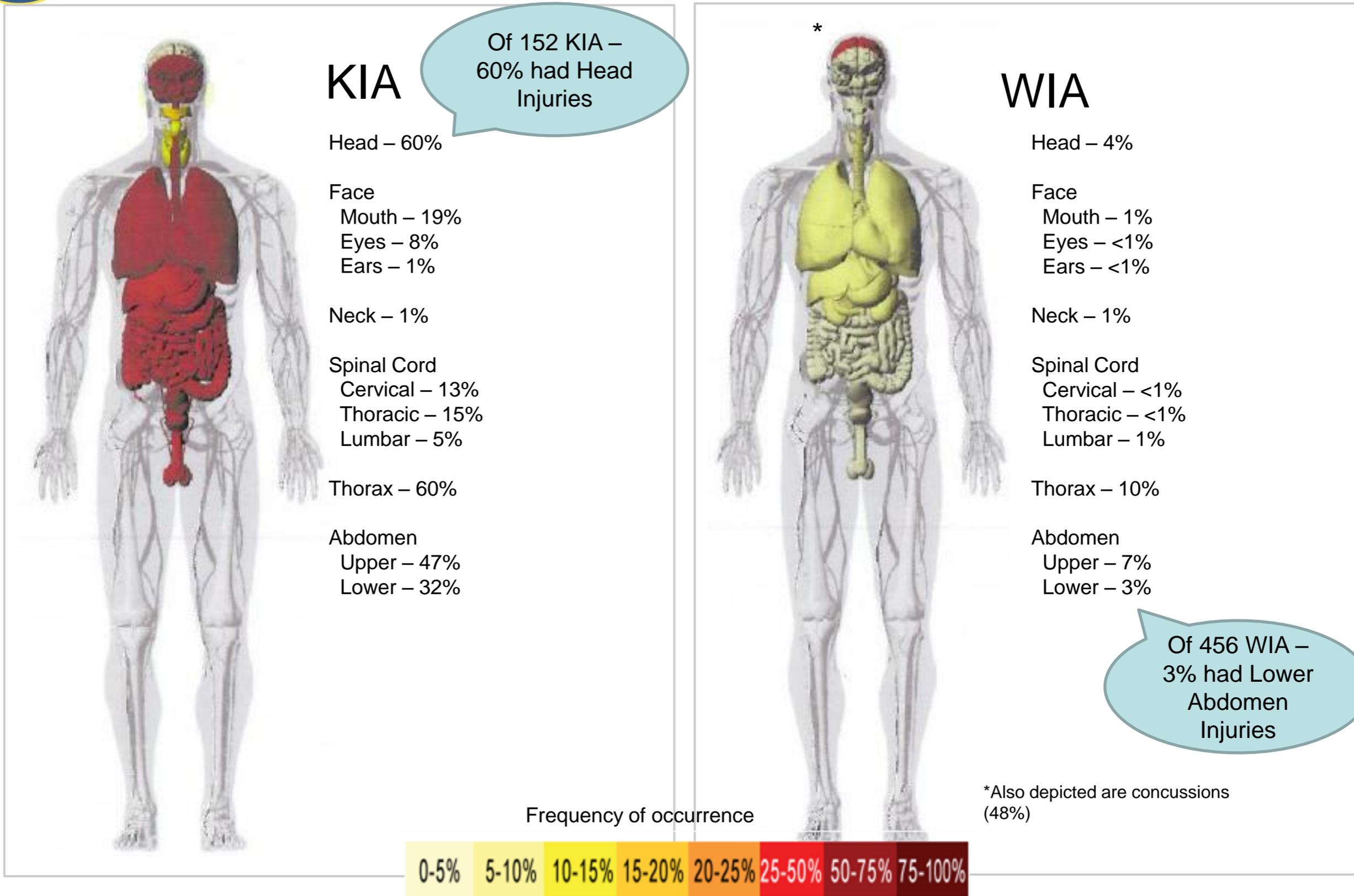
UNCLASSIFIED

Percentage of casualties with specific fractures





Percentage of casualties with specific internal organ injuries

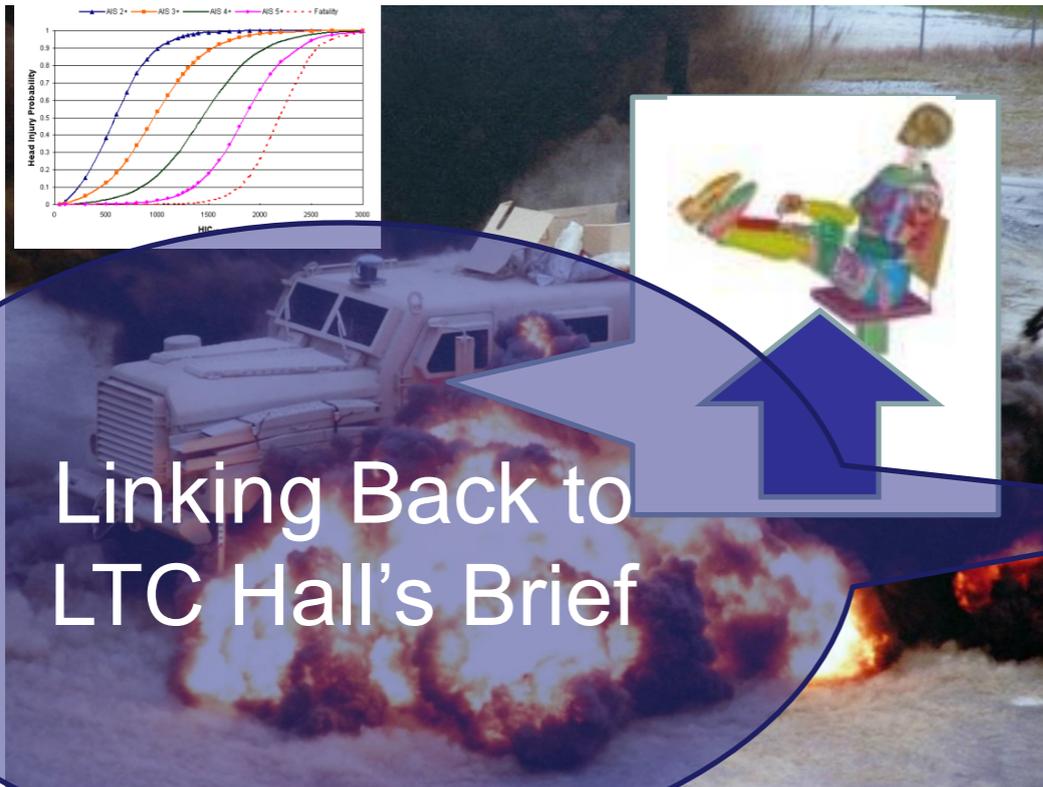




Medical Research Plan



WIAMan Program Overview



Linking Back to LTC Hall's Brief

Schedule

MILESTONES	FY12	FY13	FY14	FY15	FY16	FY17
Define Warrior Environment	█					
Cadaveric Testing	◆	◆	◆	◆	◆	
Injury Assessment Dev.		◆	◆	◆	◆	◆
Guidance to Stakeholders	◆	◆	◆	◆	◆	◆
WIAMan Gen 1 Fab, & Test		◆	◆	◆		
WIAMan Gen 2 Fab, & Test			◆	◆	◆	◆

Milestone Indicators: TRL or SRL: ◆

Milestone Timeline: █

Purpose:

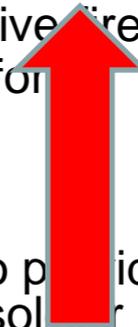
Create a Warrior-representative test dummy and associated biomedically-validated injury assessment tools for use in live fire test & evaluation and vehicle development effort

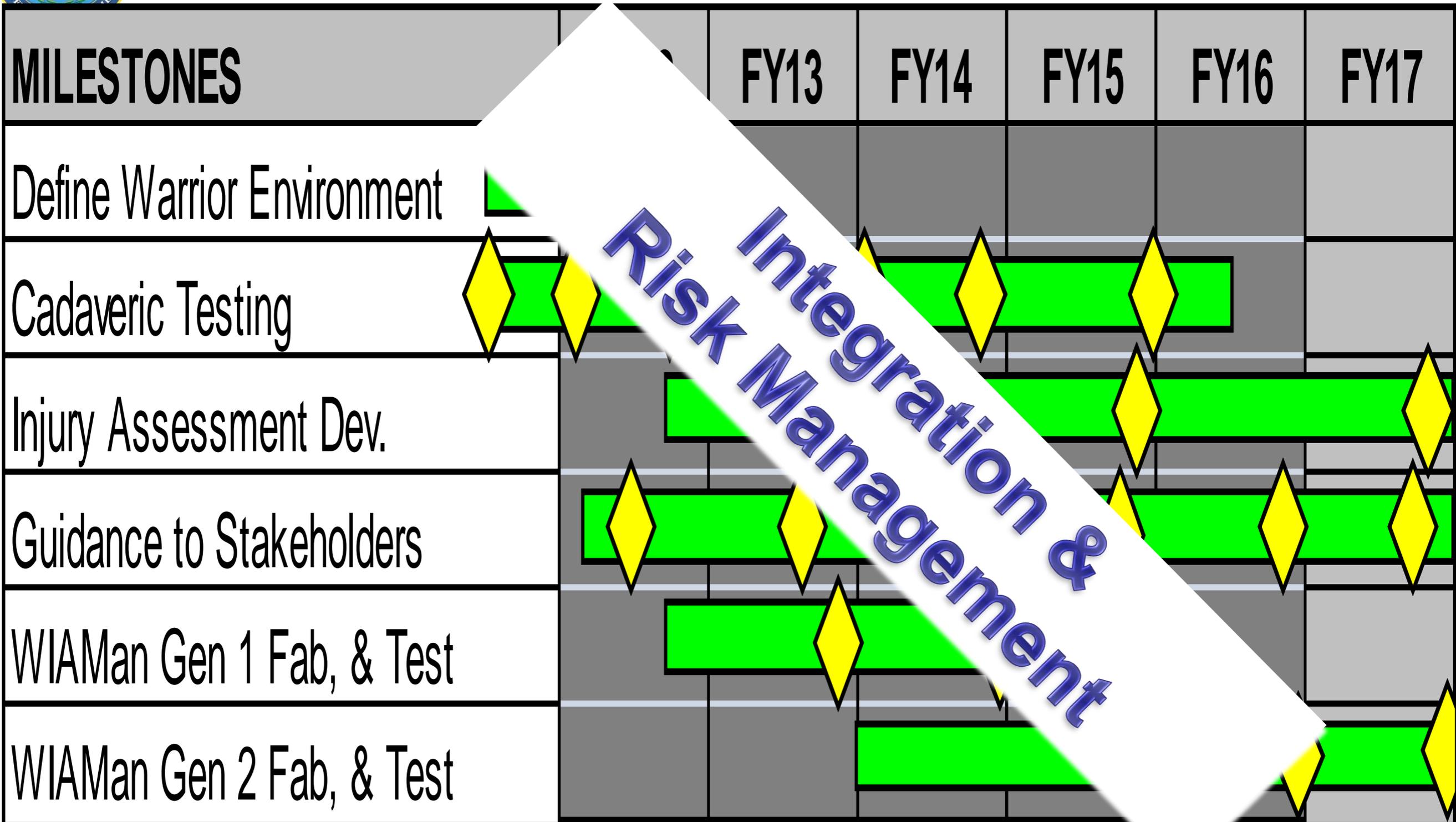
Results:

- A test dummy to provide an operationally relevant state of the art soldier surrogate
- Human response for individual body regions that inform the concurrent design of the test dummy
- A robust set of baseline data for blast events and resultant injuries
- Realistic accelerative injury response curves and analytical methods based on realistic vehicle environment in Under Body Blast testing
- Input to vehicle/weapon system designs to improve survivability

Payoff:

- Ability to accurately measure accelerative loads caused by Under Body Blast testing
- Increased knowledge of Warrior vulnerability in Under Body Blast testing
- State of the art criteria, methodologies & metrics used to assess injuries from accelerative loading sustained during Under Body Blast testing
- Potential for enhanced vehicle and soldier survivability





Risk Integration & Management

Milestone Indicators: TRL or SRL: ◆

Milestone Timeline:



Integration and Risk

- Multiple performers in Government, Industry, Academia
- Multiple contract efforts
- Injury testing to Component testing of body regions moving in parallel with a manikin fabrication effort followed by Injury Testing via a matched pair comparison to an integrated warrior representative ATD
- Consistency of Test and Evaluation methodologies across performers to ensure Verification, Validation, and Accreditation of the Injury Assessment Reference Values (IARV), Manikin, and Live Fire Test and Evaluation methodologies can withstand scrutiny
- A end product that produces an instrument that will be used to judge the safety of our ground combat vehicles



What is not included?

- TBI research that would be based on cognitive measurements
- Internal organs will not be a major focus. Internal organs will only be considered if skeletal injuries or surrogate mechanical measures can be correlated to internal organ injuries to the extent that existing/prior research can be leveraged
 - Injuries resulting from
 - Primary blast
 - Ballistic penetration
 - Blunt impact due to ballistic events (behind armor effects)
 - Frangible/expendable surrogates/criteria
 - Modeling & Simulation (beyond FEM of Manikin)
- Why?
 - Understanding of relevant injuries
 - Time, Money, Technology status
 - Risk Management of a complex project forces narrow scope
 - Testing of next family of combat vehicles



US ARMY
RDECOM



Things we would like to know?

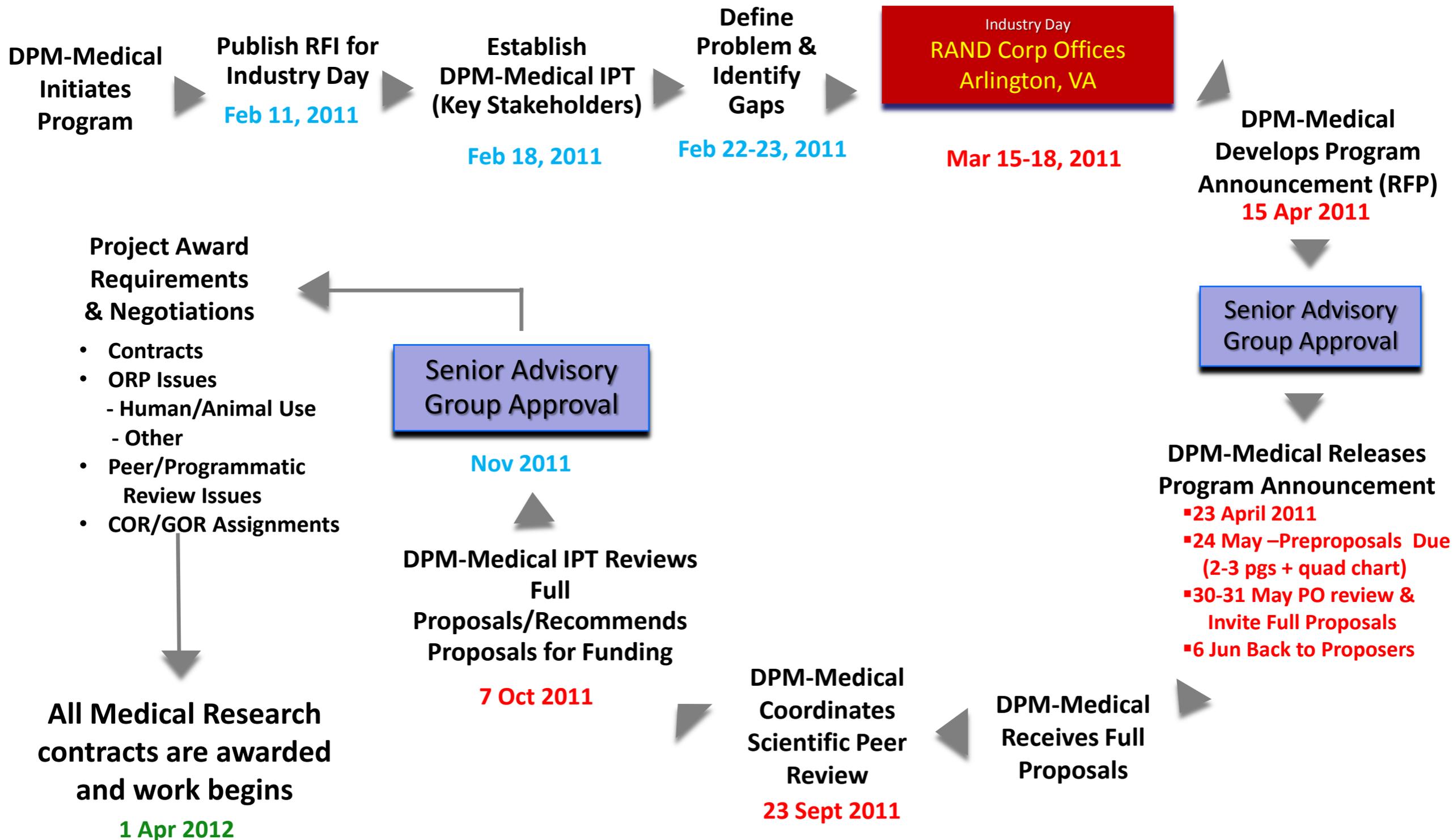
- Your capabilities and capacity to participate in the project
- Are there better ways to approach this that could save us time or money?
- Are there ways to improve the quality of the research, without increasing expense and time?
- What efforts in DoD and elsewhere are on-going, that would allow us to leverage them to achieve the program goals?



UNCLASSIFIED



Roadmap for Medical Effort





Goals

- 1. Conduct medical research to establish a scientific and statistical basis for evaluating injuries to occupants during Under Body Blast events**
2. Develop an improved blast manikin test device that incorporates the medical research which provides an increased capability to measure and predict occupant injury during Under Body Blast events.
3. Provide input to enable higher fidelity modeling and simulation and improve the criteria, methodologies, and metrics used to assess warrior injuries from accelerative loading sustained during Under Body Blast test events

Linking Back to
LTC Hall's Brief