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Prescribed by ANSI Std Z39-18
Agenda

- DoD Blast Injury Research Program History and Governing Directive
- Executive Agent (EA) Responsibilities and Program Coordinating Office (PCO) Functions
- Defense Health Program TBI Research Approach
- PCO Initiatives
  - State-of-the-Science Meeting on Non-Impact, Blast-Induced mTBI
  - DoD Brain Injury Computational Modeling Expert Panel
  - Blast Injury Prediction Tool Assessment Process (BIPTAP)
Background

Program History

- Established by SECDEF in Jul 06 in response to Congressional mandate (Section 256, FY06 NDAA)
- Objective to coordinate medical research focused on the prevention, mitigation and treatment of blast injuries
- Governing regulation is DoD Directive (DoDD) 6025.21E—Medical Research for Prevention, Mitigation, and Treatment of Blast Injuries, 5 Jul 06
- SECARMY (Executive Agent) delegated to ASA(ALT) then to Cdr, MEDCOM
- Program Coordinating Office (PCO) established at USAMRMC in Jun 07

Key PCO Functions

- Identify blast injury knowledge gaps and prioritize research to fill gaps
- Oversee the JTAPIC Program to enhance Warfighter survivability
- Recommend blast injury prevention standards, including protection equipment performance standards for DoD
- Leverage expertise from industry, academia, and federal agencies to solve difficult blast injury problems
- Serve as “one-stop-shopping” for blast injury research information: (https://blastinjuryresearch.amedd.army.mil)
## Defining “Blast Injuries” (DoDD 6025.21E)

**Unique to Blast**

<table>
<thead>
<tr>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
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<tbody>
<tr>
<td>- Blast lung</td>
<td>- Penetrating ballistic (fragmentation) or blunt injuries</td>
<td>- Fracture and traumatic amputation</td>
<td>- Burns</td>
<td>- Illnesses, injuries, or diseases caused by chemical, biological, or radiological substances (e.g., &quot;dirty bombs&quot;)</td>
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<td>- Eardrum rupture and middle ear damage</td>
<td>- Eye penetration</td>
<td>- Closed and open brain injury</td>
<td>- Injury or incapacitation from inhaled toxic fire gases</td>
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<td>- Abdominal hemorrhage and perforation</td>
<td>- Blunt injuries</td>
<td>- Crush injuries</td>
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<td>- Eye rupture</td>
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<td>- Non-impact, blast-induced mTBI?</td>
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</table>

*Psychological trauma (including PTSD)*

*Added based on latest research suggesting a high risk of developing PTSD following a concussion*
## Program Responsibilities

(DoDD 6025.21E, Medical Research for Prevention, Mitigation, and Treatment of Blast Injuries)

<table>
<thead>
<tr>
<th>Responsibilities and Functions</th>
<th>DDR&amp;E (ASBREM Chair)</th>
<th>ASD (HA) (ASBREM Co-Chair)</th>
<th>SECARMY (EA)</th>
<th>SECNAV &amp; SECAF</th>
<th>USUHS</th>
<th>CJCS</th>
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<tr>
<td>Oversee EA</td>
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<td>Approve Blast Injury Research Programs</td>
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<td>Ensure new technology is transitioned to DoD Components</td>
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<td>Assist in requirements development and needs assessments</td>
<td>✓</td>
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<tr>
<td>Approve blast injury prevention, mitigation &amp; treatment standards</td>
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<td>Ensure MHS information systems support the EA</td>
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<td>Program, budget and execute DDR&amp;E approved program</td>
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<td>Support joint database for improving protection systems (JTAPIC)</td>
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<td>Recommend blast injury prevention, mitigation &amp; treatment standards</td>
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<td>Appoint ASBREM Reps</td>
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<tr>
<td>Coordinate all blast-injury efforts and requirements through the EA</td>
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</table>
Continuum of TBI Care Determines Research Approach

**RESEARCH NEEDS**

**Injury Prevention**
- Medical Standards for Protective Equipment
- Objective Measure of Head Impact Exposure

**RDT&E:**
- Valid Criteria & Objective mTBI Concussion Screening Tool
- Portable Fieldable Diagnostic Device (In Theatre & Garrison)
- Pharmaceuticals & Surgical Technology
- Recovery Timexcourse & Rehabilitation
- Valid RTD Standards & Measures of Rehabilitation

**Psych Health and Related Symptoms**
- 2. mTBI/Concussion Prevention/Education & Training
- 3. Possible mTBI/Concussion from Impact or Blast
- 4. mTBI/Concussion Screening (DoD Guidelines)
- 5. mTBI/Concussion Assessment
- 6. mTBI/Concussion Treatment
- 7. mTBI/Concussion Recovery
- 8. Reset

**Return to Duty/Disability/Reclassification Assessment**

**Continuing Education and Reinforcement for Soldiers, Leaders, and Service Providers**
- Nutraceuticals, Standards for Helmets, Education/CPG's for Soldiers, Leaders & Service Providers
- Head Impact/Blast Injury Dosimeter
- Validated Definition and Technologies: EEG, TCD, Eye Tracking, Vestibular Ocular Assessment, ICP Device, Biomarkers
- Cognitive, Behavioral, and Neurological Assessments (CT, EEG, fMRI, DTI, MRS, etc.)
- Medications, Novel Interventions
- Evidence-Based Rehabilitation Protocols, Measures of Rehabilitation Progress
- RTD Standards, Evaluation/Measurement

**SOLUTIONS**

16 Feb 2011
Assessed what we know and don’t know about the existence and mechanisms of this injury

Attendees from DoD, VA, DOT, academia, and industry (Canada, Japan, the Netherlands, Sweden & USA)

Key Findings:

- Evidence from clinical and animal studies that this injury can occur, but with many caveats
- Insufficient evidence to support one injury mechanism
- Insufficient data to support changes to Warfighter protection systems

Identified knowledge gaps and recommended improvements in research project coordination and data sharing

Established DoD Brain Injury Computational Modeling Expert Panel
Objective: To assess the state-of-the-science in computational modeling of non-impact, blast-induced mTBI and to integrate DoD research efforts to accelerate the transition of preventive and treatment strategies

Institutions represented: DoD, other government agencies, academia, industry, and international researchers & clinicians

Deliverables (starting March 2011):
- Develop TBI community benchmarking (model specifications, sharing, comparative analyses, and validation)
- Laboratory Benchmarks to Support Model Validation (In-vitro, animals, and surrogate)
- Validation strategy (In-vitro to in-vivo and scaling from animal to human)

Focus on injury mechanism and “translating” mathematical models to support prevention and treatment strategies
Brain Injury Computational Modeling Challenges

- Developing validated constitutive models for material properties of skull, cerebrospinal fluid (CSF), and brain tissue, particularly for large strain rates and for perfused tissue
- Developing mechanical dose-response models of brain tissue dysfunction
- Developing an objective method to measure blast exposure
- Modeling impact (obtaining the correct parameters for contact and friction) between brain and cranium
- Developing benchmark loading paradigm to facilitate model comparison and validation
- Determining how to properly account for the presence of large cerebral blood vessels, bridging veins, and brain perfusion
- Developing adequate models of tissue response/mechanical injury (material failure)
- Modeling soft tissue
- Exploring the issue of cavitation
- Developing criteria for animal models that reproduce injury (determining endpoints)
- Establishing linkages to neurobiology
- Establishing solid models across multiple geometric scales
- Solving brain biomechanics equations using finite element method solvers for soft tissue (overcoming numerical difficulties)
- Simulating long-time transient brain biomechanics during secondary injury development (e.g., edema, hematoma, and herniation)
- Understanding how mechanical energy translates into a concussion
- Coupling whole body and the brain
- Understanding thresholds for injury (e.g., determine whether closed head injury thresholds for TBI in civilians can be applied to mTBI)
Blast Injury Prediction Tool Assessment Process (BIPTAP)

- Fulfills EA responsibility to identify and recommend blast injury prevention standards to ASD(HA) for approval and DoD-wide application.

- Initial focus on tools for assessing fire gas inhalation injury and performance effects to support health hazard and combat vehicle crew survivability assessments.

- Johns Hopkins University/Applied Physics Laboratory developing the process for the PCO:
  - Identify relevant blast injury prediction models
  - Establish independent review panel
  - Establish review criteria
  - Host evaluation conference
  - Recommend standards to PCO

- PCO will staff recommendation to ASD(HA)


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