Systems Engineering Approaches and Opportunities to Improve Traumatic Brain Injury Care in the Military Health System

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Abstract: (Your abstract must use Normal style and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

INTRODUCTION: We summarize identified opportunities to apply systems engineering methods to help optimize the design, effectiveness, and capacity of the U.S. military and VA healthcare systems for detecting and treating traumatic brain injury (TBI) among servicemen during and post deployment. Mild through severe TBI have been described as a signature injury and silent epidemic of the Afghanistan and Iraq wars, estimated to affect 19.6% of servicemen.

METHODS: A two-day workshop was co-sponsored in June 2008 by the National Academy of Engineering, Institute of Medicine, and US Army Medical Research and Material Command to identify potential contributions from the systems engineering field. Five workgroups focused on different aspects of the problem, summarized in Systems Engineering to Improve Traumatic Brain Injury Care in the Military Health System (978-0-309-12758-5). Pilot projects have been initiated by the lead author to test the feasibility of some of the proposed models.

RESULTS: The proposed research focuses on descriptive and prescriptive models to address six integrated needs: sequential screening processes to identify at-risk individuals, diagnostic methods to estimate TBI severity, capacity and resource estimation methods, disease progression models, treatment decision-informing models, and service location models. Preliminary projects have been initiated to develop (1) probability and simulation screening models to help identify servicemen with some type of TBI, (2) longitudinal updating diagnostic models using fuzzy logic, multinomial regression, and neural networks to help predict TBI severity, (3) simulation models to determine regional care capacity requirements, and (4) location-allocation optimization models to assign health services and patients to facilities.

DISCUSSION: Significant potential exists to apply systems engineering methods to help improve TBI care processes. In some cases, extensions to methodological theory are necessary (and feasible), such as to address missing data, screening and care compliance, transient post deployment populations, and uncertainties in soldiers’ history and future military actions.