BIO-FI: LEVERAGING THE POWER OF BIOLOGICAL BIG DATA FOR ADVANCED ANALYTICS AND MODELING OF CHEMICAL AND BIOLOGICAL THREATS

Modeling Warfighter Performance Degradation Following Chemical/biological (cb) Exposures: Improving Model Outputs To Better Estimate Mission Readiness And Force Lethality

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Understanding warfighter performance degradation following chemical/biological (CB) exposures has long been of interest to the defense community. In the 1990s, the DNA Improved Casualty Estimation (DICE) program began quantifying performance degradation following exposures to varying levels of sarin (GB) and sulfur mustard (HD) vapor whilst performing various infantry and artillery tasks. DICE established a performance degradation scale quantifying how much longer a soldier takes to complete a given task under a given exposure scenario, and later served as the basis for casualty estimates in NATO's Allied Medical Publication 8 (AMedP-8). In the late 1990s, the Defense Special Weapons Agency (DSWA, predecessor to DTRA) developed performance degradation models for biological agent exposures. These models used legacy data collected during Operation Whitecoat (1954-1973) involving laboratory-controlled human exposures to the agents causing tularemia, Q fever and SEB. The resulting models, in which body temperature was used to predict performance degradation as a function of time during early febrile illness, addressed combat effectiveness for DSWA/DTRA purposes and were later used to construct casualty models for AMedP-8.

NATO's CBRN Medical Working Group then established standard sign/symptom (S/S) injury severity levels across representative CB agents and related the progression of S/S levels to casualty-related patient streams. This scale consisted of five levels, beginning with no effect at the first level to lethal or near-lethal effects at the fifth level. These levels were primarily created to inform medical planners on patient presentation, but each description also contained some language relevant to operational planners. However, this approach was not intended to provide a commander with the critical soldier combat effectiveness information necessary to inform battlefield strategy following a CB agent exposure.

Current models of warfighter performance degradation following CB exposures are inflexible and individualized to specific agents. In this work, we will develop a more flexible framework to quantify warfighter performance degradation following exposures to a representative range of chemical and biological agents. This framework will be S/S-dependent, account for timing after exposure, and classify performance degradation using an operationally-relevant set of terms. Following rigorous external review, we will make these outputs available in HPAC as an enhancement to the current performance degradation tool.

This framework and the resulting outputs will better quantify operational impacts affecting both individual- and population-level mission readiness and force lethality at different phases of the joint deployment and redeployment processes. Restructuring current models of warfighter performance degradation following CB exposures will provide meaningful, interpretable outputs that will enable commanders to make more informed battlefield decisions.

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