NEXT GENERATION CB HAZARD PREDICTION AND CONSEQUENCE ASSESSMENT WITH MULTI-ECHELON DECISION SUPPORT APPLICATIONS

Strategies For Whole Body Combined Exposure - Focus On Nerve Agents For Fxcoda

Mario Citra SRC Inc. **Stephen Houghton** SRC Inc. **David Crary** Applied Research Associates (ARA) **Jason Rodriguez** Applied Research Associates (ARA)

Current injury estimations typically only assess one exposure route for injury predictions. However, warfighters are rarely exposed via one exposure route. Hence, SRC, Inc in conjunction with Applied Research Associates (ARA) have been developing a novel model for predicting injury from combined exposure routes for a nerve agent. The current method for combining exposure routes in FXCODA assumes illness presentation is similar regardless of exposure route. This is particularly true for severe exposures. Using this assumption the current FXCODA model defines an effective inhalation dosage (ED) that is the sum of the inhaled vapor, the percutaneous vapor, and the percutaneous liquid. The method employs scaling factors to relate the effects of percutaneous vapor and percutaneous liquid to inhaled vapor. Upon calculation of ED, FXCODA then applies the exposure duration and toxic load exponent for inhalation exposures, and then integrates the ED dosage distribution (from the mean dosages/depositions and associated variances) with the inhalation dose response curve to calculate a probability of effect. However, there are several gaps associated with this methodology including: Mild exposures can lead to significantly different presentations of illness depending on exposure route; The differences in toxic load between inhalation and percutaneous are not accounted for; and onset of injuries will be significantly different between percutaneous and inhalation exposures.

The new model being developed by ARA and SRC accounts for time dependent inhalation and percutaneous dermal exposures. The inhalation toxicology model predicts blood acetylcholinesterase (AChE) and organophosphate blood levels as a function of time using rat data for sarin which was translated to human exposure by allometrically scaling certain parameters such as blood volume, breathing rate and noted differences in blood biochemistry between rats and humans. The inhalation portion of the model takes the form of two coupled differential equations describing the inhalation process and the toxicokinetics of organophosphates and acetylcholinesterase (AChE) in the bloodstream. In addition, we developed a simple model for blood concentration as a function of time following dermal absorption of sarin, with the intention of using the output of the model as an input to the toxicokinetic model. We are testing this model with other agents including the less volatile substance VX.

This new model will allow a more accurate prediction of chemical injury effects and will better inform and facilitate the course of medical treatment.

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