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INSTITUTE FOR DEFENSE ANALYSES

# Proceedings of the Conference on Defining the Attributes of a CBRN Human Response Model: Consensus Development December 4-5, 2006

Carl A. Curling
Julia K. Burr
Lusine Danakian
Deena S. Disraelly
Margaret R. Porteus
Terri J. Walsh
Robert A. Zirkle

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**About This Publication**

This work was conducted by the Institute for Defense Analyses (IDA) under contract DASW01-04-C-0003, Task CA-6-2281, "Revision of NATO Planning Guide for the Estimation of Battle Casualties," for the United States Army Office of the Surgeon General, Task DC-6-2533, "Analytic Capabilities Development," Defense Threat Reduction Agency Joint Science and Technology Office, and Task EQ-6-2602, "Mathematical Modeling of Medical Consequence Measures," Department of Health and Human Services Office of Public Health Emergency Medical Countermeasures. The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or Department of Health and Human Services the sponsoring organization.

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# PREFACE

This document reports work performed by the Institute for Defense Analyses for the United States Army Office of the Surgeon General, the Defense Threat Reduction Agency Joint Science and Technology Office, and the Department of Health and Human Services Office of Public Health Emergency Medical Countermeasures in partial fulfillment of the following task orders "Review of NATO AMedP-8 *Planning Guide for the Estimation of Battle Casualties*," "Analytic Capabilities Development," and "Mathematical Modeling of Medical Consequence Measures" respectively. This document includes the conference proceedings and associated briefings for the consensus development conference held in December 2007.

The authors wish to thank the reviewers, Dr. Sid Baccam, Dr. Michael Boechler, LTC Mark Bohannon, USA, Ms. Angel Fitzgerald, Mr. Steve Krall, Ms. Jennifer Olson, Dr. Erin Reichert, Dr. Katherine Wallace, Mr. Doug Schultz, and Mr. Nafis Upshur, for their careful review of this document, and Ms. Shelley Smith who edited and produced this document.

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# EXECUTIVE SUMMARY

This paper provides a summary of and briefings from the CBRN Human Response Model: Consensus Development Conference, held at the Institute for Defense Analyses in December 2007. The purpose of this two-day conference was to develop consensus within the user community regarding the particular attributes that users felt should be included in the next generation of combined CBRN human response models. [1] Prior to this conference, the IDA study team interviewed current and potential users of human response models within over thirty civilian and military organizations. Their answers were collected, analyzed, and presented at this conference as a starting point for discussions.

The purpose of this study was to develop an understanding of the attributes required for a coordinated CBRN human response model that could be used by three user communities: the US Department of Defense (DoD)—both military operational and support communities, US civilian government organizations, and North Atlantic Treaty Organization (NATO). by the civilian and military operational and support communities. Additionally, the study sought to identify areas where community views continue to diverge, by choice or necessity; provide an opportunity for communication among the various members of the military and civilian communities; and consider the potential implementation of alternate human response methodologies within one or more tools. The results of this study are presented in *Defining the Attributes of a CBRN Human Response Model*, IDA D-4214.

The first set of presentations at the conference aimed to familiarize all members of the user community with existing models and tools that dealt with human response or conducted casualty estimation. The second set of presentations, organized into sessions, presented in detail the points of consensus and divergence within the user community regarding specific human response model attributes, as discussed in the interviews, including:

- Users and Uses, to address the scope of applications that CBRN human response models are expected to meet;
- Inputs to prescribe what information should be used as model inputs;
- Output, Time, and Methodologies to describe significant attributes of the CBRN Human Response models;

[1] A human response model, also known as a casualty estimation model, is usually one component of a larger suite of models. For our purposes, the human response model is used to estimate the status over time of personnel exposed to some event involving CBRN agents (or influenza). The model estimates the number of people who may be expected to require medical treatment, as well as the number of anticipated fatalities due to the insult.

- Tool and Application, while not dealing directly with the models themselves, to describe oft-raised concerns of users regarding the applications that implement the model.

The final briefing reviewed the consensus points developed by participants during the two days of the conference.

This study was jointly sponsored by the Joint Science and Technology Office of the Defense Threat Reduction Agency (DTRA), the Biomedical Advanced Research and Development Authority (BARDA) of the US Department of Health and Human Services (HHS), and the US Army Office of the Surgeon General (OTSG) in its role as the US representative to the NATO CBRN Medical Working Party.

# I. DEFINING THE ATTRIBUTES OF A CBRN HUMAN RESPONSE MODEL: CONSENSUS DEVELOPMENT CONFERENCE PROCEEDINGS

**Institute for Defense Analyses**

The purpose of this two-day conference was to develop consensus within the user community regarding the particular attributes that users felt should be included in the next generation of CBRN human response models. Prior to this conference, the IDA study team interviewed current and potential users of human response models within over 30 civilian and military organizations. Their answers were collected, analyzed, and presented at this conference as a starting point for discussions.

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The sponsors of the IDA study were the Defense Threat Reduction Agency (Mr. Charles Fromer), the US Army Office of the Surgeon General (MAJ Kevin Hart), and the Department of Health and Human Services (Dr. Peter Highnam).

Dr. Carl Curling, the study lead at IDA, opened the conference by presenting the agenda and objectives.

### Introduction to the Use of Human Response Models, Carl Curling, IDA

In this presentation, Dr. Curling discussed the nature and purpose of human response models. In particular, he focused on the various questions that could be asked of human response models and the different ways that these types of models may be used.

### Human Response Models for DTRA, Charles Fromer, DTRA (S&T)

Mr. Charles Fromer discussed the role of the Joint Science and Technology Office (JSTO) in the development of the information systems science and technology capability area. He discussed the different areas of technology pull, including battle space management, medical surveillance modeling and simulation, hazard and environmental modeling transport and

dispersion, and chemical and biological warfare effects on operations. He explained that the modeling effort is being sponsored by JSTO and brought back into the tech base in order to develop capability for biological, chemical, and radiation events, and eventually, toxic industrial chemicals and toxic industrial materials (TICs & TIMs). The aim is to maintain use of one edition among departments, so that addressing the same question results in the same answers interdepartmentally, inter-DoD, and internationally.

**Human Response Models for DHHS, Peter Highnam, DHHS (OPHEP)**

This presentation briefly introduced the Office of Public Health Emergency Medical Countermeasures (OPHEMC) and their two major activities – Project Bioshield and Avian Influenza planning. Dr. Highnam described his role as responsible for integrating modeling through a shared understanding of the problem and answer. He explained that subject matter experts are engaged at every level and integrated in both the planning and modeling efforts.

Questions were asked regarding the role of the Veterans' Administration in modeling discussions and the responsibility for evacuate/shelter-in-place decisions. Regarding the Pandemic Flu plan, Dr. Highnam indicated that the final version of the plan has not been released yet but is being developed in coordination with DHS and DoD. He described the MIDAS PanFlu model collection effort as a combination of subject matter experts and tools, resulting in realistic, nuanced answers.

Regarding the incorporation of "worried well" populations into the models, Dr. Highnam replied that while it is not an immediate concern for an effectiveness determination, it has come up, particularly with regards to medication distribution discussions.

**Human Response Models for NATO, James Smith, Army OTSG**

This briefing, presented by James Smith of the Army's Office of the Surgeon General (OTSG), describes OTSG's roles and responsibilities for medical CBRN issues in NATO, the relevant NATO CBRN medical documents (Standardization Agreements (STANAGs) and Allied Publications)), and the role and structure of the NATO Standardization Agency (NSA). The briefing also described in detail NATO's cyclical development and approval process for STANAGs and Allied Publications.

**Current Models: Allied Medical Publication-8 (AMedP-8), Julia Burr, IDA**

Allied Medical Publication 8, *Medical Planning Guide for the Estimation of NBC Battle Casualties*, is an example of the application of human response models to casualty estimation. This document, published in nuclear, biological and chemical volumes, provides estimates over

time of casualties, fatalities and residual operational strength after NBC attacks against static, tactically deployed units. The guide consists of a series of lookup tables showing the status of unit personnel over time, casualties and fatalities over time, and unit personnel categorized by injury or illness severity.

**Current Models: Nuclear, Biological & Chemical Casualty & Resource Estimation Support Tool (NBC-CREST), Gene McClellan, ARA**

Dr. McClellan discussed the background or basis of the tool, NBC-CREST and provided an overview of how this tool can be used in casualty estimation and medical planning. The development of NBC-CREST originated at the US Army Office of the Surgeon General, but has since been transitioned to the Defense Threat Reduction Agency's Nuclear Technology Directorate. The purpose of this tool is to "enable advanced planning for medical operations in an NBC environment." ARA is currently working to update NBC-CREST for DTRA.

- Sponsored by Eric Nelson, DTRA
- Some capability to track civilians, but the same data and algorithms were used for them as is used for military, as a "simple bookkeeping of surrounding civilians"
- Plans to include civilians?
    - Yes, but not well formulated
    - Census block data, land scan database were used
    - Takes no account of demographics
- Incorporates DMSB Task Time Treater Files
- Air Force (AF) and Marines have logistics supply numbers.
- Different casualty estimations exist for Army ground forces than for AF pilots.

**System to Automate the Benchmark Rate Structure (SABERS), George Kuhn, LMI**

LMI is developing a tool, SABERS, for conventional casualty estimation.

- Included discussion about the applicability of Vietnam era concepts for casualty rate estimation to present day operations.

**Medical Surveillance System (MSS), Rashid Chotani and Angel Fitzgerald, DTRA**

- Models are given TRL levels (3 and 6)
- BMIST—SOF uses it now.

**Common User Database (CUD), Ellen Kavanaugh, DMSB**

- Version 1 delivered 1 December; it brings together Word and Access.

**Joint Operational Effects Federation (JOEF), Dave Hoffman, JOEF APM**

- Automated planning tool
- Medical modeling includes human response and resources requirements determination

- Increment 1, before attack, deliberate planning and crisis planning (more M&S)
- Increments 2 and 3, decision support before and after attack (incident response and consequence management for civilian agencies, DoD and coalition forces—more maps, tools, specific mention of CHART tool)
- JOEF examines tasks is a manner similar to the USAF STAFFS model
- JOEF has to interoperate with JEM, JMAT, DMML.

**Determining Human Response Model Attributes—Session 1: Interview Process, Carl Curling, IDA**

In this presentation, Dr. Curling discussed the method or process used by IDA to go about determining human response model attributes. He briefly discussed the status of current human response models with the human response model in AMedP-8 as a specific example. He discussed the drivers behind the task for each of the three sponsors—DHHS, DTRA, and Army OTSG. He described the interview process for gathering attribute information from current and potential human response model users, and provided a summary of the results of this process.

- It was noted in the discussion that "human response" as defined in this context is sometimes referred to as "human effects"
- A request was made to add capability developers (e.g., JCIDS) to "users and uses" list.

**Determining Human Response Model Attributes—Session 2: USERS & USES Attributes, Deena Disraelly, IDA**

Ms. Disraelly presented the results of the attribute collection interview process pertaining to the Users and Uses of human response models. Various comments and suggestions were made by participants:

- The model users listed in slide 3 are also applicable to the VA.
- There was general consensus that the military operational users (slide 6) can be summarized by saying "command and flag level staffs." In particular, attendees also recommended the incorporation of J-4.
- There was a suggestion that WMD Civil Support Teams be added to the list of users (POC offered by Ellen Kavanagh). Also suggested was the incorporation of DSCA (the Defense Security Cooperation Agency) and Dr. Tom Hopkins at NDU.
- There were suggestions to add to the list of civilian users the following organizations: FBI; VA (health, policy, and police divisions); Metropolitan Medical Response System; Civil Engineering.
- There was agreement regarding the list of current models/applications that are used.
- The lack of guidance (or perhaps discipline) at the interagency level or even DoD level for a specific model to be used consistently was noted. Furthermore, the importance of training and awareness for existing and new models was stressed.
- Military operational users reach back to the experts because either they don't have the expertise themselves, or because that's what they've been told to do.

- Some other applications were mentioned: DSP for supply estimation; TML+ used to model capacity in Navy/Marines.
- Some models are being used in the military for training/exercises.
- Models can be improved to consider the effect of countermeasures and treatment.
- Mr. Mahoney (CDC) noted that his group also mentioned natural disasters during the interview process.
- There was lengthy discussion about the scope of human response models in this task. Particularly, are natural disasters within the scope? Is resource determination with the scope?
- There was discussion about some of the responses provided during the interviews (e.g., language issues, hurricanes) and how they relate to human response modeling.
- There was a comment that in one interview, it took time for participants to understand that the questions pertained specifically to human response, not the resource modeling aspects, etc. Other groups may have had similar difficulty and as a result indicated attributes which should not be in the scope of human response models.
- In the viewpoint of the IDA study team, not all users can talk directly about the human response models, since they may not be knowledgeable about them, but what we can do as interviewers is understand their modeling needs, which may include understanding the modeling they do (and want to do) and issues of concern to them, which will include areas outside the direct scope of human response modeling. This information helps us understand them as users and their modeling needs, which we can then relate back to the human response component.

**Determining Human Response Model Attributes—Session 3: SCOPE Attributes-INPUTS, Carl Curling, IDA**

Dr. Curling presented the results of the attribute collection interview process pertaining to the Inputs for human response models.

- There was discussion and disagreement regarding the inclusion of certain categories within the Agents parameter:
    - Should pandemic influenza be included in this task? (arguments were made for and against this)
    - Should naturally occurring and emerging infectious diseases be included?
    - Should explosives be included? (the general consensus appeared to be “no”)
    - Should hurricanes and other disasters be within the scope of CBRN human response models? (the general consensus here seemed to be “no”)
- For the Exposure Routes parameter, participants agreed that the particular routes to be included in the model depended on agent, but should include more than just inhalation. Several additional points were raised:
    - The exposure routes are agent dependent (group generally agreed to this) and recommend prioritization of exposure route by agent.
    - Recommend the inclusion of “combined” as an exposure route
    - One participant stressed that EPA is no longer trying to pursue certain models (i.e. dermal) due to lack of valid data.

- Psychological/ "worried well" aspect is a human response and therefore should be within the scope of human response models.
- There was agreement that the Population at Risk parameter be dynamic, scalable, and differentiable.
- There was discussion on the importance of demographics and what demographics were significant; attendees generally agreed that they want to be able to differentiate certain groups in the population, but could not agree on which groups should be differentiable.
- There was a recommendation that the group of model users help create a forum for prioritization and determination of data gaps.
- There was agreement that in general parameters should be included where data is available.
- For Medical Protection, prioritize countermeasures that are FDA-approved.
- Attendees agreed to the consensus point that medical protection be modeled for all available items, and that associated behavior and compliance must also be considered. They stressed, however, that data may not exist, and that it is important to recognize this in the model.
- Attendees agreed to the consensus point that technical detection and syndromic surveillance should be included when applicable.
- Concern was raised regarding HIPAA and the inclusion of surveillance and medical detection into the model. Surveillance and medical detection results are inputs into the models, but the systems remain separate from the models, thus mitigating privacy concerns.
- One attendee raised questions regarding "recovery as an endpoint." Medical models allow for a modifiable definition of recovered, whereas in operational models that level is usually a set value. Ideas for the appropriate definitions of "recovery" could be passed on to DMSB for inclusion in Task Time Treater Files.

**Determining Human Response Model Attributes—Session 4: SCOPE Attributes- OUPUTS & TIME, Lusine Danakian, IDA**

Ms. Danakian presented the results of the attribute collection interview process pertaining to the Outputs and consideration of Time in human response models. Several comments and suggestions were made by participants:

- A valid term must be used instead of "worried well."
    - The suggestion was made to use "concerned public" or "highly sensitized population."
    - In the report, it should be noted that "worried well" was mentioned repeatedly, even though participants knew the term was no longer valid.
- Use "performance capability" consistently instead of "performance level."
- As an additional output category, include "location where people will report (clinic, hospital, stadium, etc.)"; this may help determine triage resource requirements.
- Susceptibility/ vaccination status may be an additional filter for casualty type.
- During the discussion of treatment requirements, the suggestion was made to tie in patient unit with code; additionally, exposure groups were recommended as a basis for grouping patients.

- Participants discussed the appropriateness of using "first-responders" as a term to include the military medical staff and installation response force.
- Participants discussed the necessity for incorporating hazard/risk confidence assessments into the model. The question was asked whether users are willing to input their uncertainty in the inputs. The answer was both yes and no, depending on the user. The method of expressing risk was also discussed – "Commanders don't want numbers; they want a low risk, a moderate risk, or a high risk." Recommendations were made to use a SME panel to help determine confidence levels and to include confidence level expression as a user-selectable option.
- Both time and time duration need to be considered in the models.
- There was discussion about "chronic" and "delayed" time periods, and the need for defining these terms and many others up-front in the final report of this study (use "protracted" rather than "delayed"). Participants noted that in toxicology, "chronic" effects are defined as effects lasting seven years or longer.

**Determining Human Response Model Attributes—Session 5: METHODOLOGY & TOOL Attributes, Julia Burr, IDA**

Ms. Burr presented the results of the attribute collection interview process pertaining to the Methodology of human response models and characteristics of a Tool for these models. There was general agreement with the consensus points presented within these two topics. Several comments and suggestions were made by participants:

- Combined effects need to be included into methodology.
- Documentation should be readily available for all aspects of the methodology.
- Criteria need to be established for the "well-documented" attribute on the list.
- Underlying algorithms should be made available to interested users.
- Default scenarios should be included as a training tool.
- Outputs should be saved in a repository by the tool (lifecycle management of outputs) to be able to recreate results.

**Determining Human Response Model Attributes—Session 6: Way Ahead, Carl Curling, IDA**

Dr. Curling discussed the way ahead for this study. He presented lists of military and civilian user community representative that have been interviewed by the IDA study team to date, and those that will be potentially interviewed in December and January. He also presented a timeline for the continuation and completion of the study. Dr. Curling requested input from conference attendees for a prioritization for organizations that had not been interviewed to date. The group attempted to prioritize the military list only, since the civilian community was not well-represented at the conference:

- Military first priorities include CSTs and Marine Corps senior operating force surgeon at one of our interviews.

- During the meeting, LtCol Gillen, USAF, scheduled a Model Attributes Discussion with representatives of the Air Force.
- Additional priority should be given to the following organizations: NORTHCOM, STRATCOM, and TRADOC.
- Discussion occurred about whether NDU and school houses, customers of the product, should be considered high priority interview candidates
    - TRADOC published a report that the Army did not concur with. Need to get them engaged in this effort, too.
    - Some others thought that TRADOC shouldn't be at the top of the priorities list
- The final report of the study should include a comment about the significance of the latest agent fate within the modeling process, so that it could be obtained from DTRA.

# II. BRIEFINGS

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# A. INTRODUCTION OF THE USE OF HUMAN RESPONSE MODELS – BRIEFING

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# Introduction of the Use of Human Response Models

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
4 December 2006

## What Are Human Response Models?

- CBRN human response models characterize the effects of exposure to various CBRN agents and insults on humans
- Human response models estimate:
  - Expected incidence of illness or injury resulting from CBRN exposure
  - Expected fatalities resulting from CBRN exposure
- Human response models can also estimate:
  - Time of illness or injury onset
  - Nature and severity of signs and symptoms
  - Time to death or recovery

## Why a New Human Response Model?

- Several different models and tools are currently available for estimating human response, but
  - They often provide conflicting or inadequate answers
  - They are not applicable in all circumstances
  - They do not always incorporate the most current scientific research
- A new, coordinated human response model would
  - Provide different users with the same answer to the same question
  - Facilitate communication at all levels of government among agencies and organizations with responsibility for CBRN response



## Conference Objectives

### Primary

- Develop a consensus on the attributes that a human response model should have

### Secondary

- Identify areas where community views will continue to diverge
- Provide an opportunity for communication among members of the military operational, military support, and civilian communities
- Consider alternative paths for implementation of a new human response model within one or more tools

## Conference Structure

**Monday, 4 December**

- Sponsor views
- Existing models
- Interview process and preliminary results
- USERS and USES

**Tuesday, 5 December**

- INPUTS
- OUTPUTS
- TIME
- METHODOLOGY
- TOOL
- Way Ahead



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# Questions?

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## B. HUMAN RESPONSE MODELS FOR DTRA – BRIEFING

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# Information Systems Science & Technology Capability Area

Brief to IDA Conference:
Defining the Attributes of a CBRN Human Response Model
4 December 2006

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## JSTO IS Taxonomy

| THRUST AREAS | THRUSTS | THRUST MGRS |
|---|---|---|
| Network Architectures | Battlespace Management | Ginley |
| | S&T Data Backbone | Lowenstein |
| | Rapid Assimilation of Sensor Information Research | Hannan |
| | Medical Surveillance Systems | Chotani |
| Hazard and Environmental Modeling | Transport and Dispersion | Fry |
| | Environmental Science | Hamiltion |
| Simulation, Analysis and Planning | Operations Effects | Fagan |
| | Decision Support S&T | Miller |
| | Medical Effects Modeling | Fitzgerald |
| Systems Performance Modeling | Test and Evaluation Performance Eval Models | Sears |
| | MDAP M&S Support | Zimmerman |

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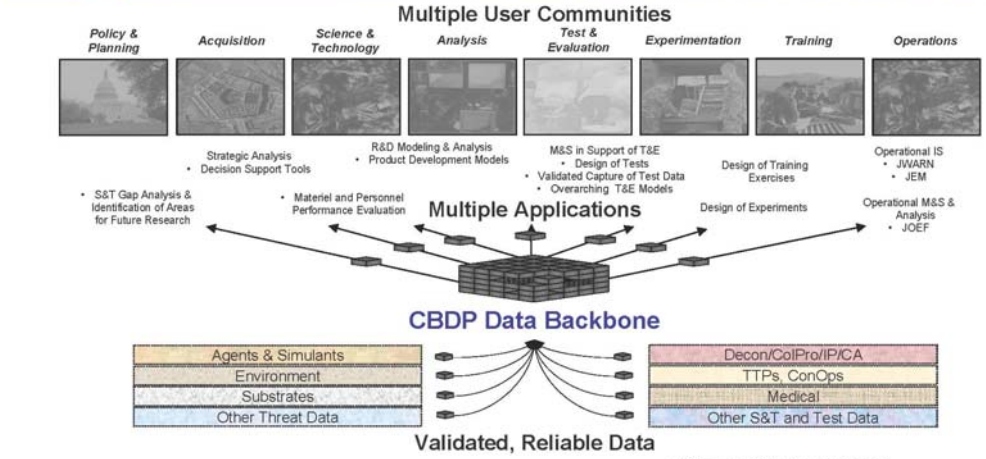
# Technology Push: CBRN Validated Interactive Data Backbone




**Project Objective:**

- Provide the scientist, analyst, and warfighter with knowledge superiority and efficiency and increase the effectiveness of U.S. defense against CBRN warfare through accuracy, interoperability, and reuse of validated CBRN data.

**Primary S&T Challenges:**

- Designing a secure, stable architecture which considers dynamic requirements on data volume and retrieval speed
- Designing a process for submission and validation of all data

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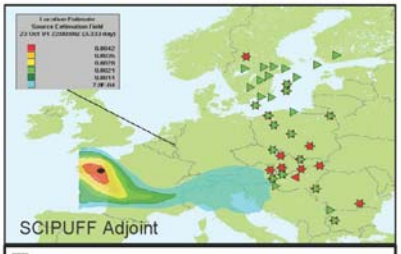
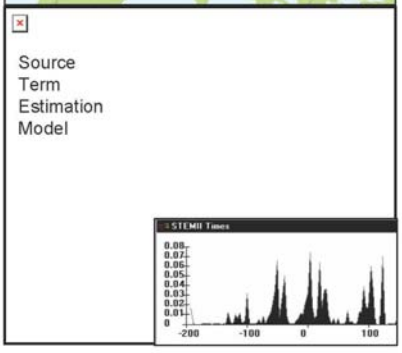
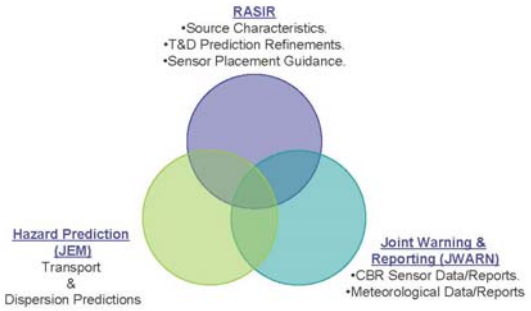
# Technology Push: Rapid Assimilation of Sensor Information Research (RASIR) Thrust – Advanced Sensor Data Fusion

RASIR Primary Goals:

- Estimate CB source
- Blend CB sensor data with dispersion model predictions
- Guidance on sensor performance and optimal placement
- Uncertainty estimates

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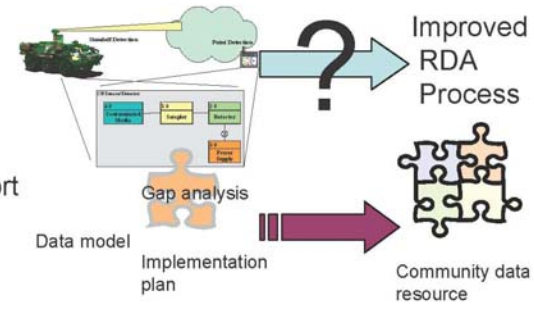
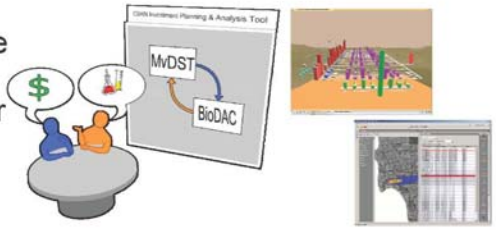
# Technology Push: Decision Support S&T

- Description of Effort: Develop the science behind tools for decision making and human knowledge management.
  - Investment/portfolio decision support
  - virtual prototyping
  - knowledge management
  - emerging technology exploration
- Objective: Improve the quality of the products, technologies and capabilities supplied to the warfighter at a reasonable cost.








# Technology Pull: Battle Space Management

- InterLAN Socket Connection Manager
  - Development of a bi-directional guard that can be certified by NSA and fielded.
  - Balance information assurance concerns with the need to touch and control sensors in the field
- JCID-on-a-Chip
  - Development of a standard interface to both military and commercial detectors to provide a plug-n-play capability.
  - Remove the need for middleware to be developed each time a new sensor is designed or integrated with JWARN.
- Shared Common Operating Picture for Homeland Security/Homeland Defense
  - Convert the language of the military (US NBC Message Text Formats (USMTF)) to the language of HLS/HLD (emergency disaster transfer language, (EDXL))
  - Determine what information is releasable between domains
  - Determine rules for classification/declassification of information across domains

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# Technology Pull: Medical Surveillance Modeling & Simulation

JOEF, JEM & JWARN requirements include minimizing warfighter casualty due to infectious diseases.

- Combine medical surveillance, modeling/simulation, early warning detection and real-time epidemiology to develop science based technologies and models.
- Evaluate the Science
  - Identify and review the various biosurveillance modeling systems & duplications
  - Assess the technology/methodology: Validate systems to illustrate strengths, weaknesses and synergies
- Incorporate models for effective early detection for use by the warfighter and homeland defense
- Implement in-theater bio-surveillance and early detection infectious disease models to predict:
  - Casualty estimation (morbidity & mortality) due to CBR agents
  - Risk of acquiring naturally-occurring diseases
- Utilize some of the new and existing initiatives being developed at DTRA (such as IDAC, ARGUS etc.) to be synergetic with the DOD Influenza Implementation Plan

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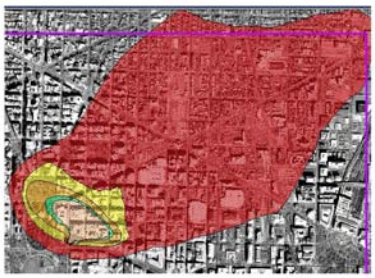
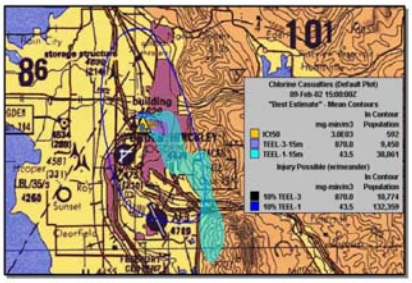
# Technology Pull: Hazard and Environmental Modeling Transport & Dispersion

- Urban Modeling
  - Urban, Terrain and Landcover Databases
  - Probabilistic Modeling
- Atmospheric Chemistry
  - Chemical Physical Properties
  - Equilibrium/Non-Equilibrium Chemistry
- Indoor Transport & Dispersion
  - Infiltration/Exfiltration
  - Explosive/Passive Release of Contaminant
- High Altitude/Missile Intercept
  - Release and Atmospheric Dispersal of Liquid Agents
- CB Source Term Modeling
  - CB Facility Modeling
  - Industrial Facility Modeling
  - Industrial Transportation Modeling



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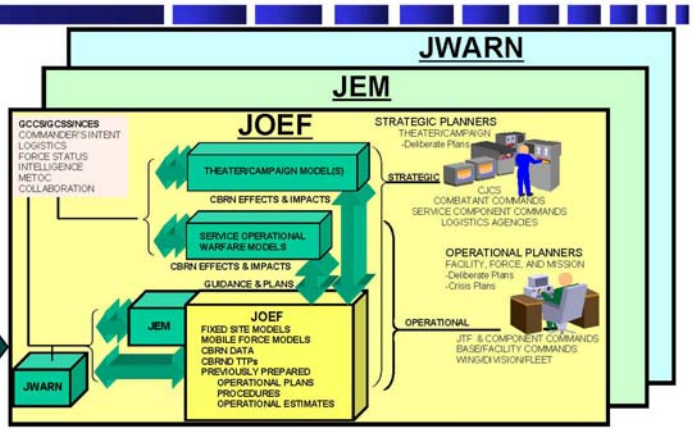
# Technology Pull: CB Warfare Effects on Operations

**Ops Effects' MS&A**
- Fixed Site (APODS, SPODS)
- Mobile Forces
- CHEMRAT
- Agent Fate Predictive Model
- Casualty Predictions
- Decision Aid Analysis




- **Apply advanced modeling, simulation, and analysis (MS&A) techniques to optimally enable the warfighter to survive, fight and win in a CBRN environment**
  - Develop technologies to provide operational (deployable) MS&A capabilities to support deliberate and crisis planning, as well as crisis and incident response/consequence management
  - Support return on investment evaluations of materiel and non-materiel CBRN defense solutions

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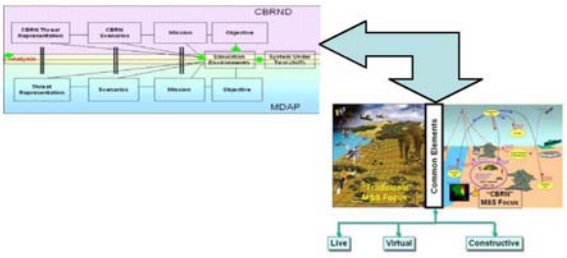
# Technology Pull: MDAP M&S S&T Thrust Area

**Objective**: ***To develop and transition supporting CB M&S for MDAP, and acquisition programs using M&S or M&S programs developing capabilities in support of acquisition.***

**Description of Effort**: **Develop the supporting tools and techniques needed to integrate CBRN M&S capabilities to acquisition programs (e.g., Future Combat Systems) using M&S or M&S programs. The scope of this thrust area is in support of acquisition programs that have a CB survivability requirement or KPP.**

**Benefit to warfighter**: **Provide coherent CB representation to acquisition programs using M&S or M&S programs**

**Approach**:




**Near-Term Projects**:
- **Near Term (FY07 – FY08)**
  - **–Transition of CB Sim-Suite to OOS**
  - **–Participate with Simulation Interoperability Standards Organization Study Group on Live, Virtual, Constructive Architecture Interoperability**
  - **–Coordination with JPEO CBD Future Systems Team**

**Challenges:**
- **Interoperability between CBR M&S and non-CBR M&S**
  - **•Challenge lies in performance, validation, and "fidelity"**

**Potential Project Areas**:
- **MDAP Areas**
  - **•Future Combat Systems (FCS)**
  - **•Expeditionary Fighting Vehicle**
  - **•Littoral Combat Ship (LCS)**
  - **•DD(X)**
  - **•Amphibious Assault Ship (LHA(R))**
  - **•Aircraft Carrier (CVN21)**
  - **•Joint High Speed Vehicle (JHSV)**
  - **•Joint Maritime Assault Connector (JMAC)**
  - **•Maritime Pre-positioning Force (Future)**
  - **•Joint Strike Fighter (JSF)**
  - **•Theater High Altitude Defense (THAAD)**
  - **•Comprehensive Force Protection Initiative (CFPI)**

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# Conclusion

- Interface between NBC CREST and HE/RC module in JOEF needs to be resolved. Propose a meeting between all parties.

- QUESTIONS?

## C. HUMAN RESPONSE MODELS FOR DHHS – BRIEFING

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United States Department of
Health & Human Services
Office of the Secretary
Office of Public Health Emergency Preparedness (OPHEP)

# Medical/Public Health Consequence Modeling

**Peter Highnam, PhD**

**Office of Public Health Emergency**
**Medical Countermeasures**

OPHEP

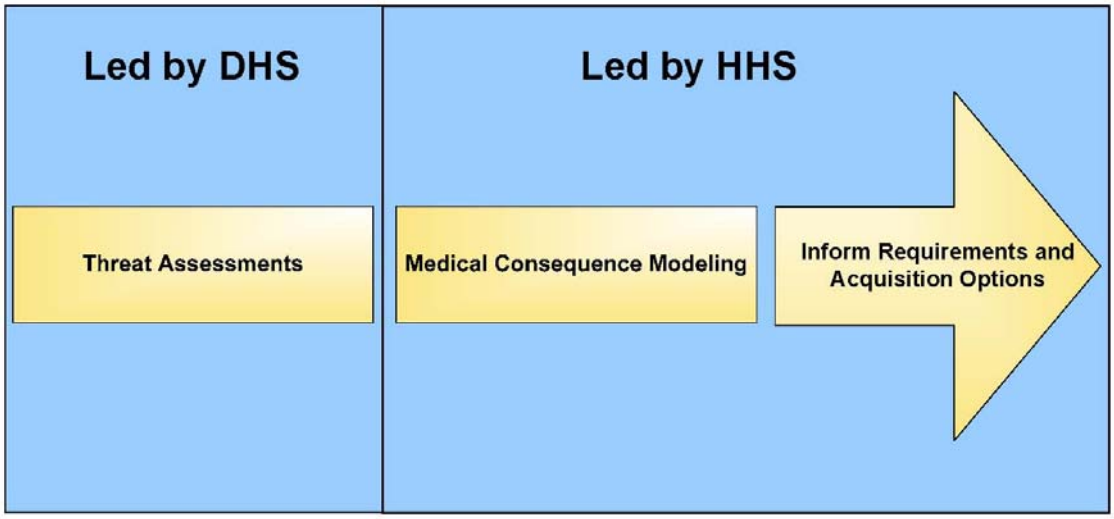
## Medical Consequence Modeling: Purpose

**As stated in the Federal Register, July 6, 2006:**

"OPHEMC undertakes public health modeling of population exposures to assist in determining requirements and assessing deployment and utilization strategies, supports late-stage medical countermeasure research and development to address prioritized requirements for addressing the health effects of naturally-occurring infectious diseases and deliberately released biologic, and chemical and radiation threats that could cause a public health emergency…"

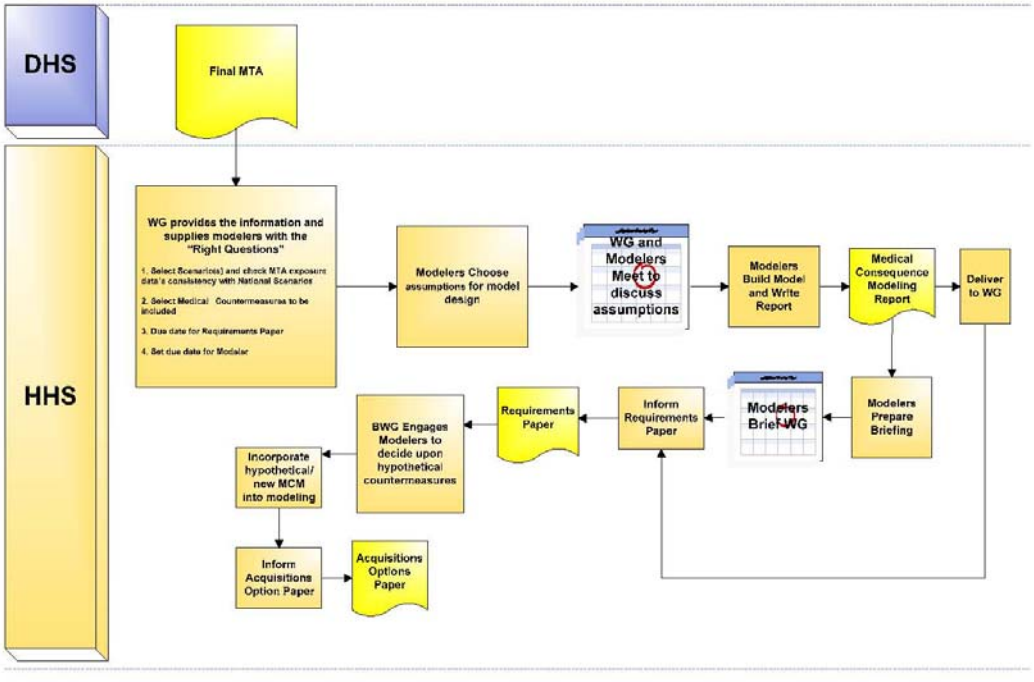
OPHEP

# Medical Consequence Modeling: Process Flow




OPHEP

# Medical Consequence Modeling: Process Flow



## OPHEP Medical Consequence Modeling: Key Points of Coordination

- DHS provides our modelers with exposure numbers via the MTA, special projects, and other arrangements.
- The interaction of modelers with the Working Groups and with Subject Matter Experts are vital.

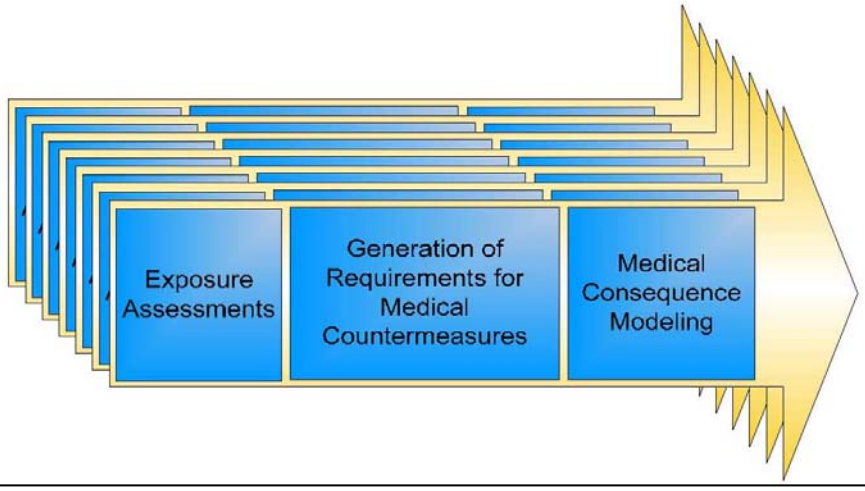
## OPHEP Medical Consequence Modeling: What questions are being answered?

Models simulate the DHS scenario to answer health questions following an event in a civilian context.

- How many people will become infected or ill?
- How many people will die?
- What difference can be made with existing or potential future medical countermeasures?
- What response times are necessary for the administration of medical countermeasures?
- What if the countermeasures do not work as well as we think they will?

## OPHEP Medical Consequence Modeling: Timeline

- Multiple threat assessments and medical consequence modeling are ongoing at the same time.

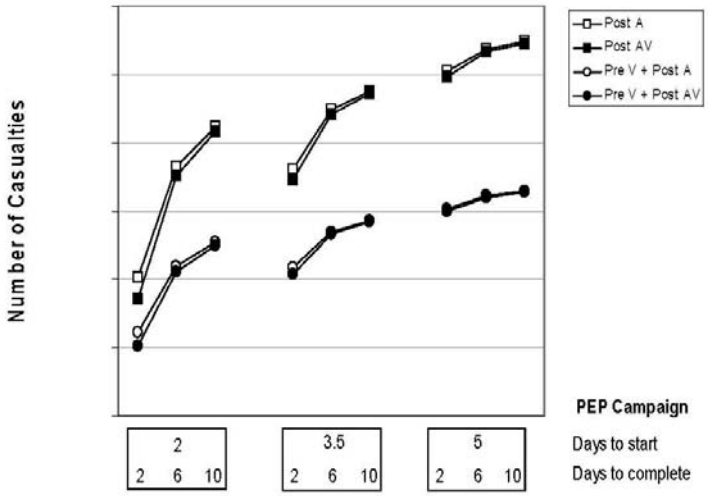



## OPHEP Medical Consequence Modeling: Challenges

- There are multiple scenarios, a diverse array of agents (including biological, chemical, radiological and nuclear) and several countermeasure options to be considered in each medical consequence model.
- In order to ask the right questions, effective communication is required between modelers, working groups, and policy makers.
- Assessing the costs and benefits of acquiring a particular combinations of medical countermeasures.

## OPHEP Medical Consequence Modeling: Anthrax Model Analysis and Conclusions

- PEP needs to be started and completed rapidly in order to be effective.
- Addition of PEP vaccination does not save many additional lives.
- Pre-exposure vaccination can greatly lower the number of casualties.
- Pre-exposure vaccination can buy time in the case of a slow PEP campaign.




*PEP: Post-Event Prophylaxis

## OPHEP Medical Consequence Modeling: Path Forward

As called out in the National Plan for Pandemic Influenza:

*HHS is responsible for coordinating with DOD and DHS to establish a "real-time epidemic analysis and modeling hub" that will "explore and characterize response options as a support to policy and decision makers…"*

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## D. HUMAN RESPONSE MODELS FOR OTSG – BRIEFING

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# Office of The Surgeon General
# Health Care Operations

## International Medical CBRN Defense Program

## Standardization Agreement / Allied Publication Development Process

4 December 2006
Mr. James Smith
Office of The Surgeon General
International Medical CBRN Defense Program
703-681-1519
James.smith38@us.army.mil

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## Purpose

To provide an overview on OTSG and Health Care Operations roles and responsibilities of the International Medical CBRN Defense Program, STANAG and Allied Publication development process, and NATO Standardization Agency organization and structure.

## OTSG/OPS Roles and Responsibilities

- Responsible for the overall international military standardization program within DA areas of responsibilities.
- Lead Agent on Medical CBRN issues
- US Head of Delegation
- Director, Health Care Operations, holds TSG signature authority

## Custodian
## Five Medical CBRN STANAGs

- STANAG 2242 – Policy for the Chemoprophylaxis and Immunotherapy on NATO Personnel Against Biological Warfare Agents
- AMedP-8 – Medical Planning Guide for The Estimation of NBC Battle Casualties
  - STANAG 2475, Vol. I (Nuc)
  - STANAG 2476, Vol. II (Bio)
  - STANAG 2477, Vol. III (Chem)
- STANAG 2873 – Concept of Operations of Medical Support in CBRN Environments, AMedP-7

## Overarching STANAGS

- AMedP-6, NATO Handbook on the Medical Aspects of NBC Defense Operations
  - STANAG 2461, Vol. I (Nuc)
  - STANAG 2462, Vol. II (Bio)
  - STANAG 2463, Vol. III (Chem)
- AMedP-7, STANAG 2873 - Concept of Operations of Medical Support in CBRN Environments
- AMedP-8 - Medical Planning Guide for The Estimation of NBC Battle Casualties
  - STANAG 2475, Vol. I (Nuc)
  - STANAG 2476, Vol. II (Bio)
  - STANAG 2477, Vol. III (Chem)

## NATO Standardization Agency (NSA)

## NSA Mission

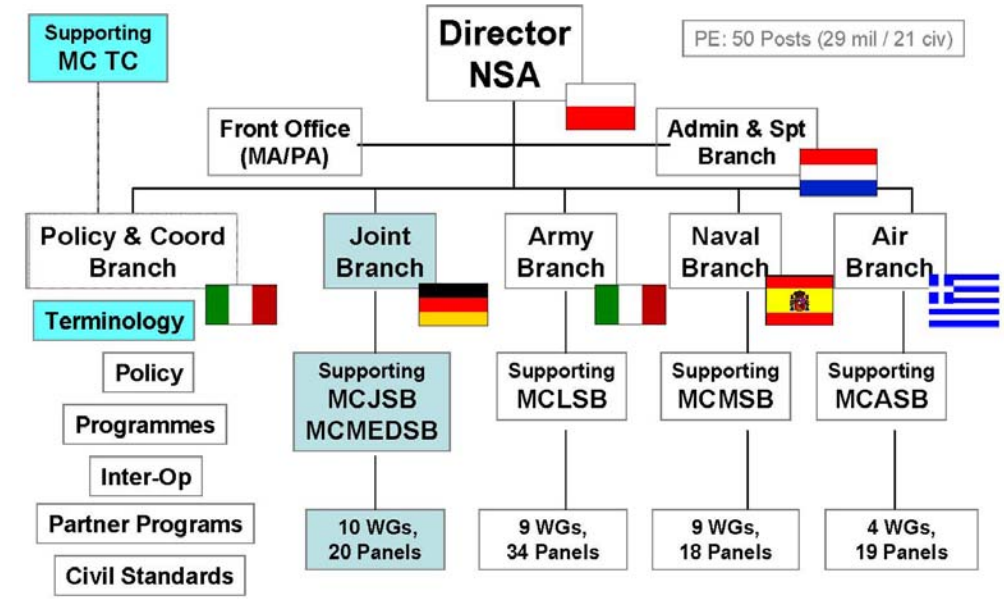
To initiate, co-ordinate, support, and administer standardization activities conducted under the authority of the NATO Committee for Standardization (NCS) and the auspices of the Military Committee (MC) as the Tasking Authority (TA) for military operational standardization matters.

## NSA Responsibilities

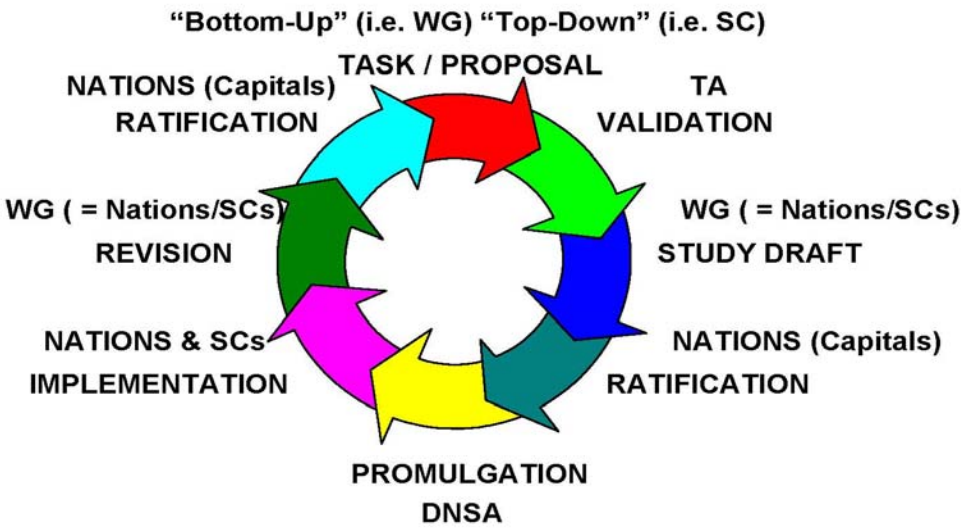
- Establish NATO procedures for planning and executing functions related to standardization
- Support MC Standardization Boards and Terminology Conference, to which the MC delegates tasking authority for operational standardization
- Coordinate the activities of the Tasking Authorities*, the IMS, the IS, the SCs and other NATO bodies concerned with standardization, and to liaise with civilian standardization organizations

** such as CNAD, NC3B, SNLC, NADC, SCEPC*

## NSA Structure and Organization




## STANAG / AP Development



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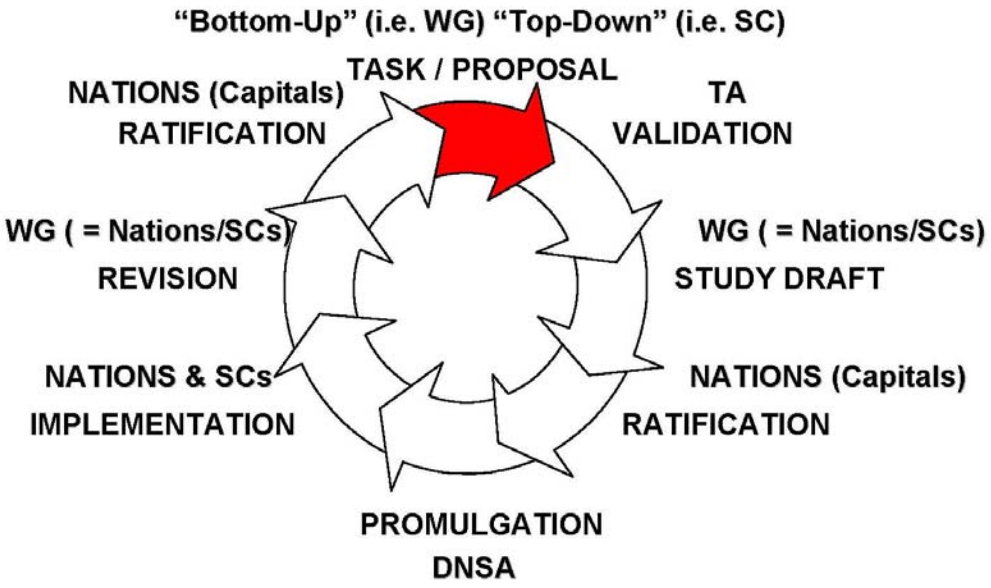


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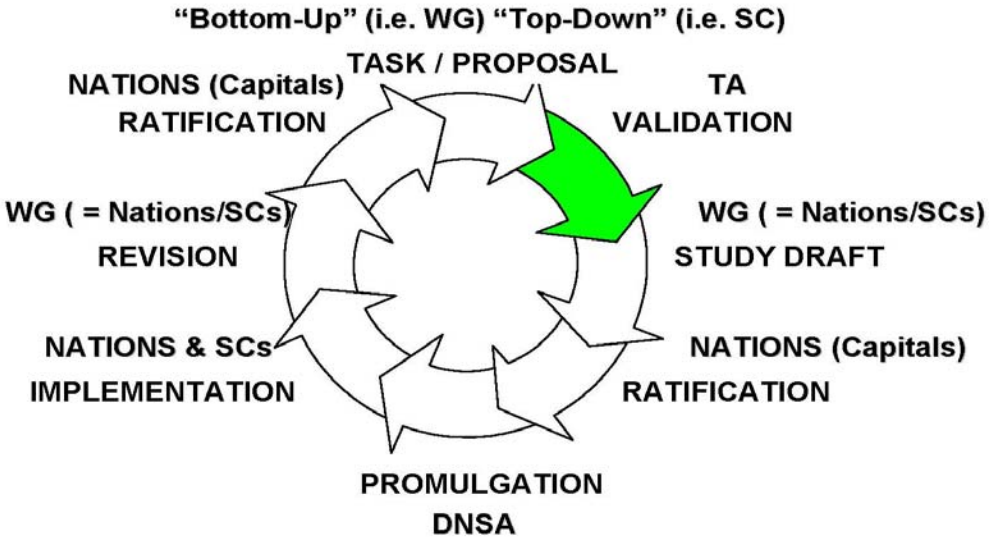
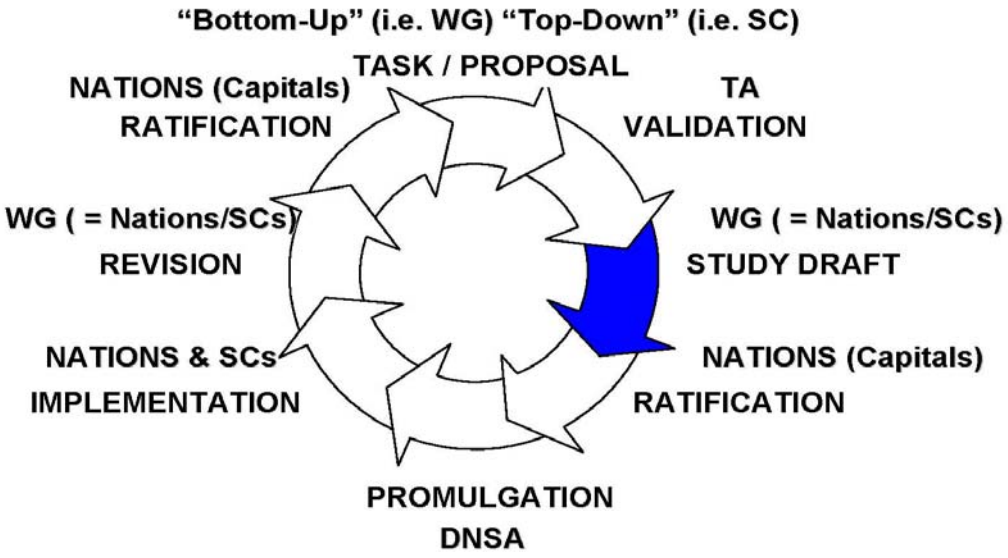


## STANAG / AP Development

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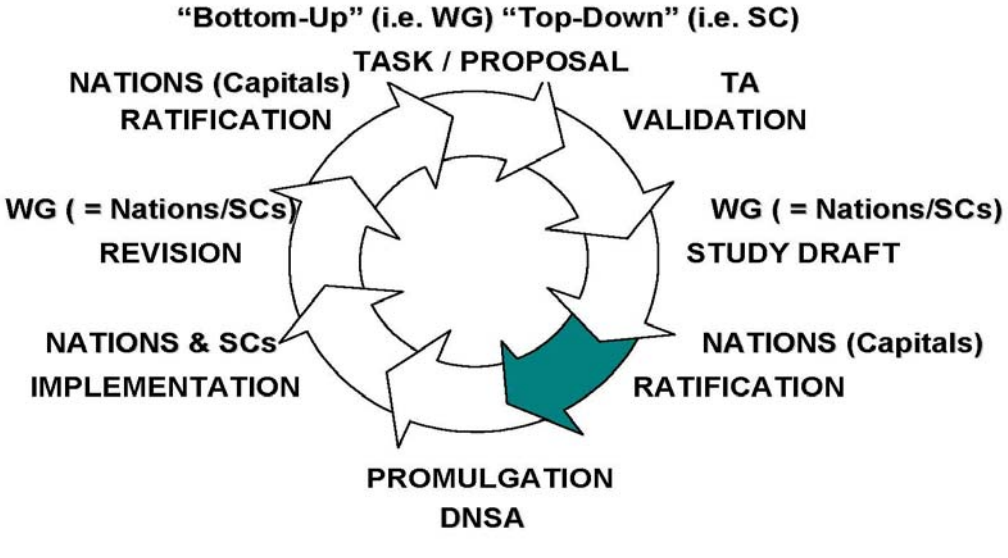

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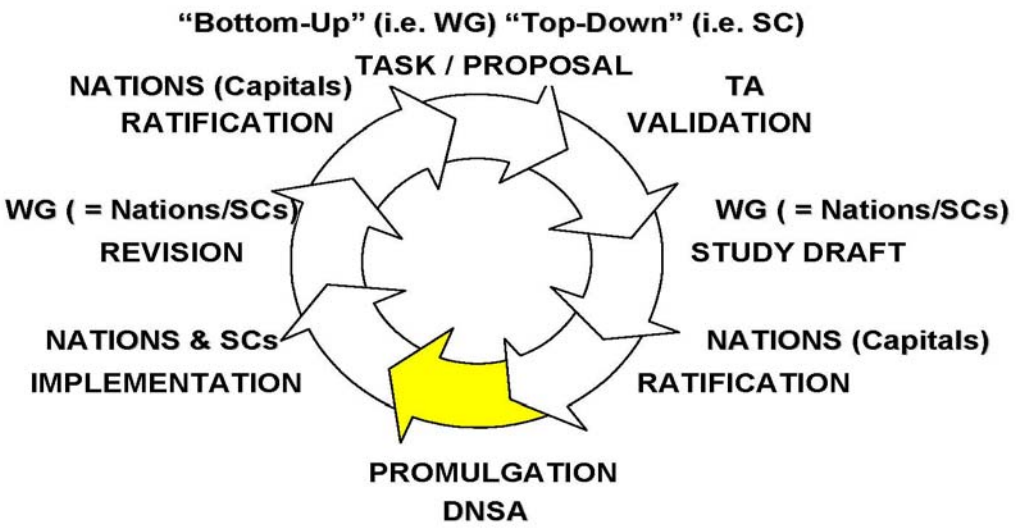


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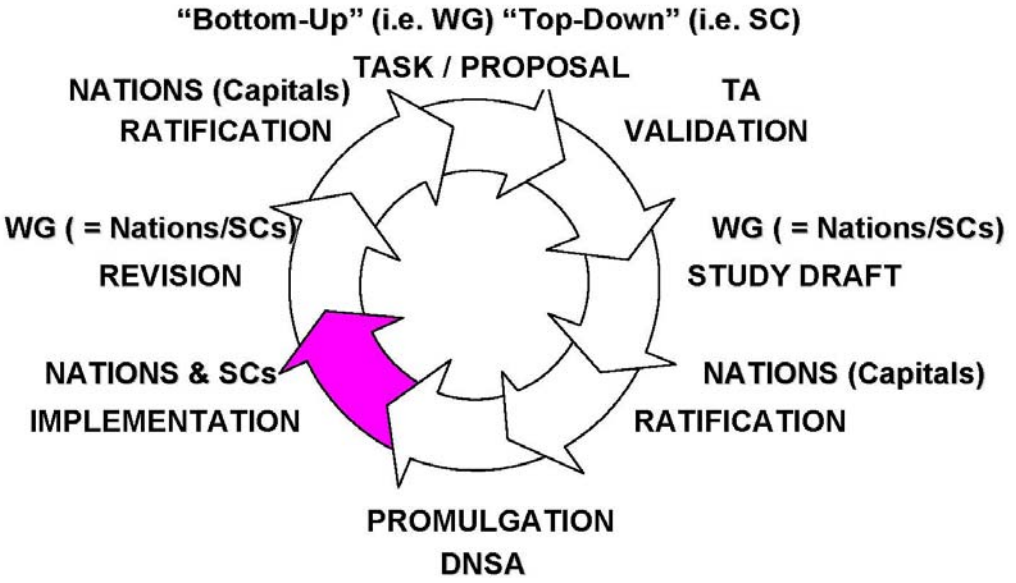

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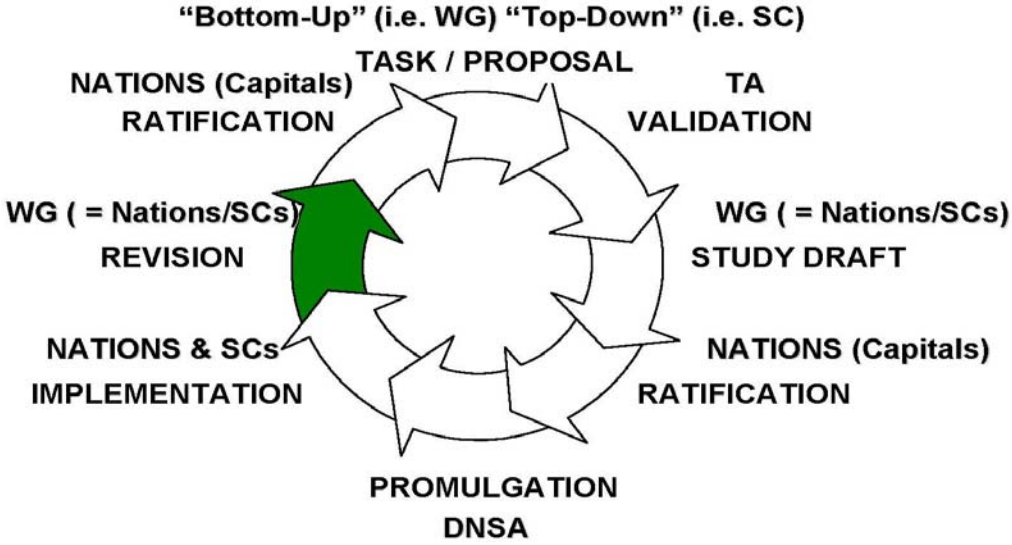


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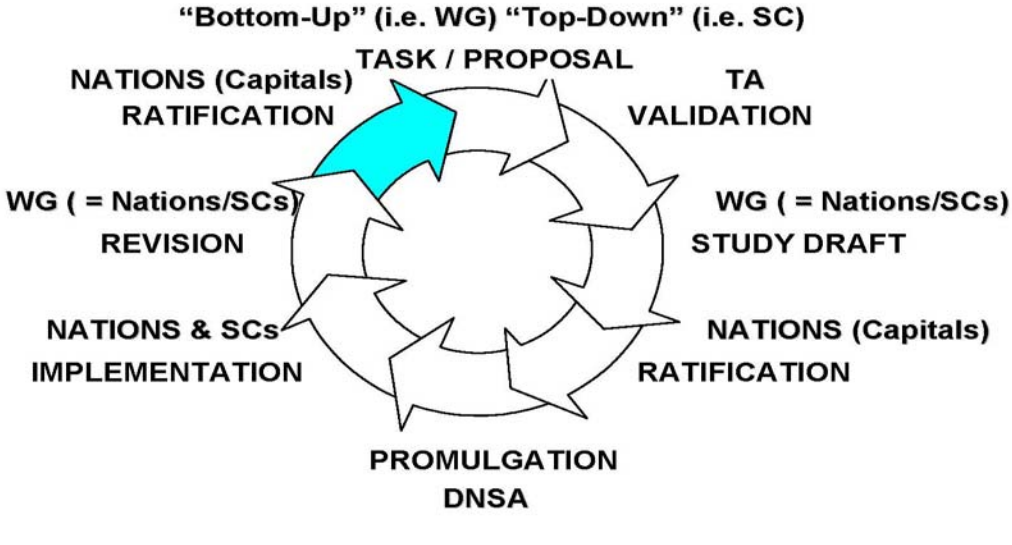
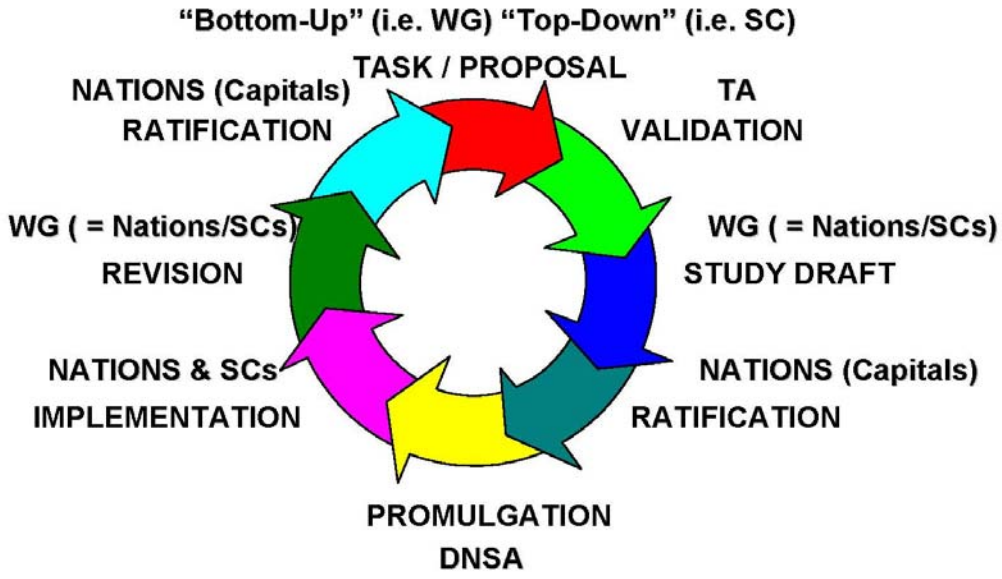


## STANAG / AP Development




## Goal

Produce a document (STANAG / AP) that all or the majority NATO nations agree to use as a common implementing document and which is distributed down to user level.

Document will be produced utilizing a standardize casualty estimation methodology that the nations can implement on their own; along with a companion tool that will provide nations with a baseline set of input and outputs compatible with any nation force structure.

## Conclusion

- Responsible for the overall international military standardization program within DA areas of responsibilities
- STANAGs and APs are produced by Boards, WGs, and Panels with NSA support
- MC Standardization Boards decide when a STANAG / AP is ready to be promulgated
- Goal is to produce a document that all or the majority of NATO nations agree to use as a common implementing document and which is distributed down to user level.

# QUESTIONS?

**Mr. James Smith**
**Office of The Surgeon General**
**(703) 681-1519**

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# E. CURRENT MODELS

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**1. Allied Medical Publication-8 (AMed P-8) Nuclear, Chemical & Biological Casualty & Resource Estimation Support Tool (NBC CREST) – Briefing**

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DEFENSE THREAT REDUCTION AGENCY

Making the World Safer

# *Medical Planning With NBC CREST*

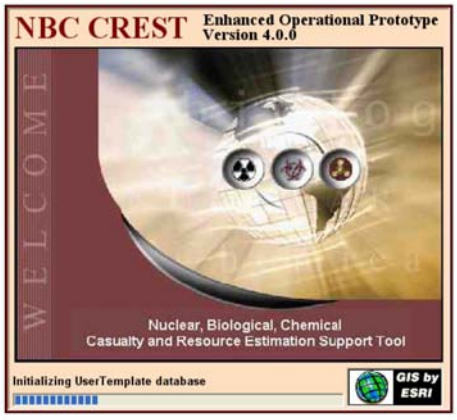
## *Defining the Attributes of a CBRN Human Response Model*

4-5 Dec 2006

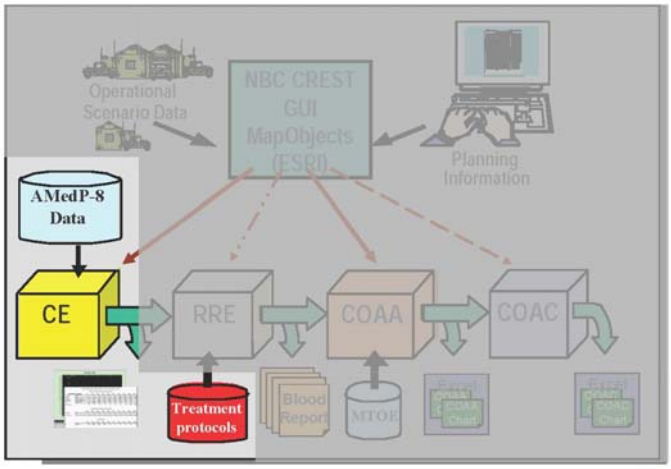
Gene E. McClellan, ARA, Inc.
Eric Nelson, DTRA/NTES

## *Medical NBC Casualty and Resource Estimation Support Tool (NBC CREST)*

- Purpose
  - Enable advanced planning for medical operations in an NBC environment
- Objective
  - Provide Medical Planners with a Tool Set to:
    - Estimate NBC casualties
    - Estimate medical requirements
    - Analyze alternate medical Courses of Action (COAs)



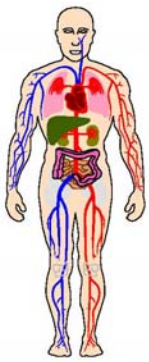
## *Human Response Models Reside in the Casualty Estimator and the Treatment Protocols*





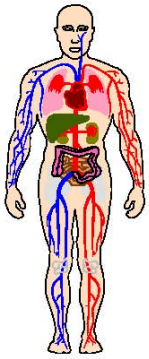

## *NBC CREST Casualty Estimation Is Based On NATO NBC Medical Planning Guides*

- Allied Medical Publication 8 (AMedP-8)
  - "Medical Planning Guide for the Estimation of NBC Battle Casualties"
- US Army OTSG is the Custodian of AMedP-8 for the NATO NBC Medical Working Group
- Promulgated in three volumes
  - Vol. I – Nuclear – 2000 – STANAG 2475
  - Vol. II – Biological – 2002 – STANAG 2476
  - Vol. III – Chemical – 2002 – STANAG 2477



## *Casualty Estimation Is Consistent Among NBC CREST, AMedP-8, and HPAC*

- AMedP-8 algorithms are based on DTRA human effects research from the 80s and 90s
  - Representative threat agents and attacks
  - Dose-dependent descriptions of human response
- HPAC effects module (CODA) is built on AMedP-8 algorithms
- AMedP-8 casualty tables provide number of dead, sick, and performance-degraded personnel over time



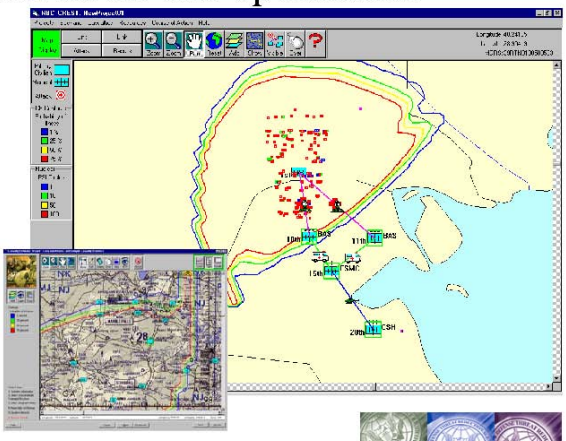
***Striving for Consistency with JEM and JOEF***



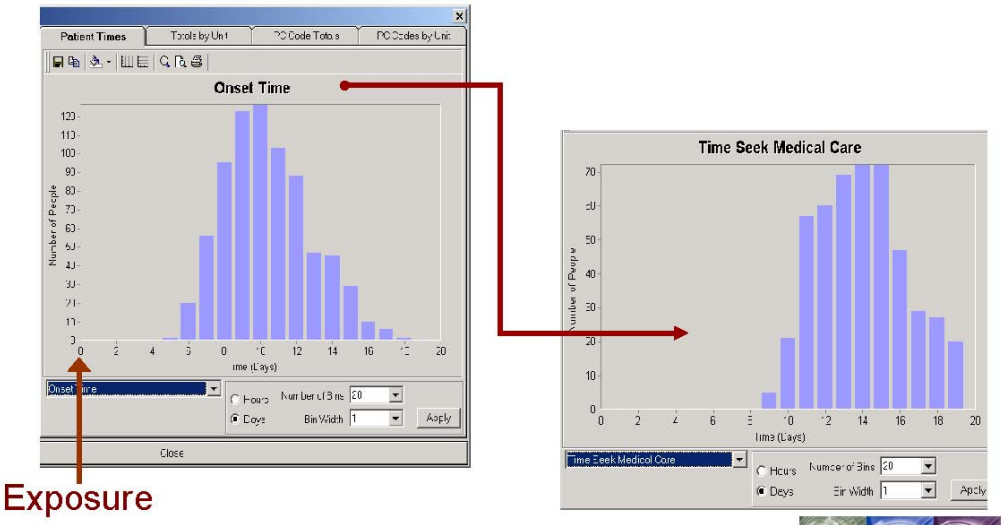


## *Casualty Estimation (CE) Module Supports User-defined Scenarios*

- Planner defines the NBC casualty/attack scenario in accordance with current threat and operational requirements
- Positions units or population on a map
- Adds network of Medical Treatment Facilities (MTFs)
- Chooses attacks
- Calculates casualties
- Saves patient stream

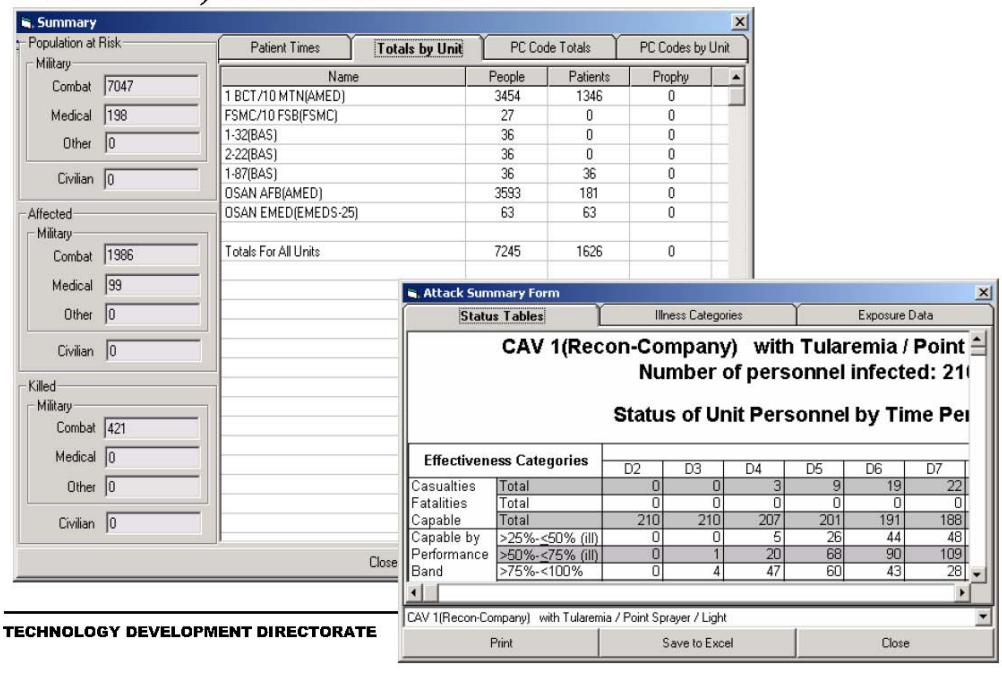


## *Smallpox Model Illustrates Time-phasing of Illness and Patient Stream*

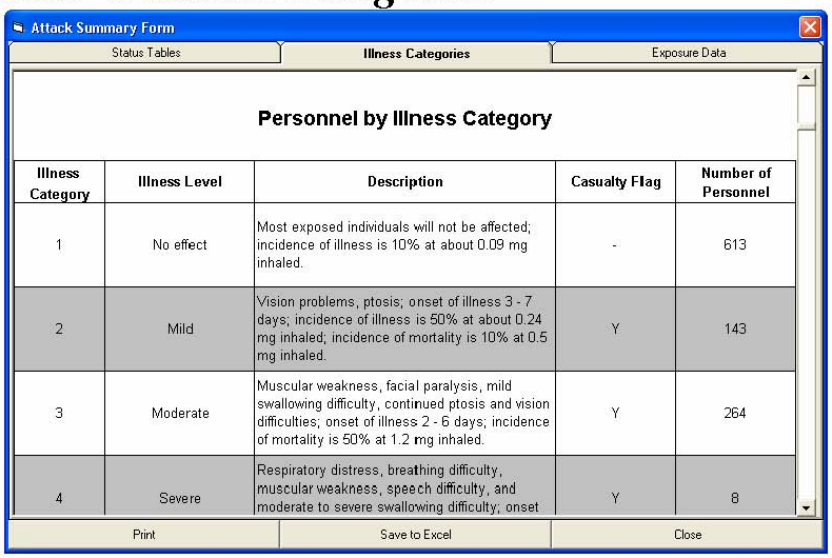





## *NBC CREST Tracks PAR, Affected, Casualties, Fatalities, and Patients*



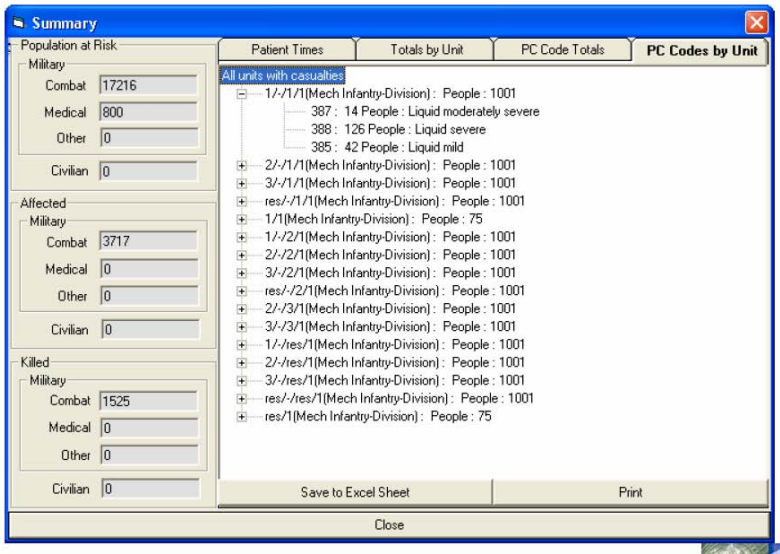
# *Tables Provide Number of Personnel by AMedP-8 Illness Categories*





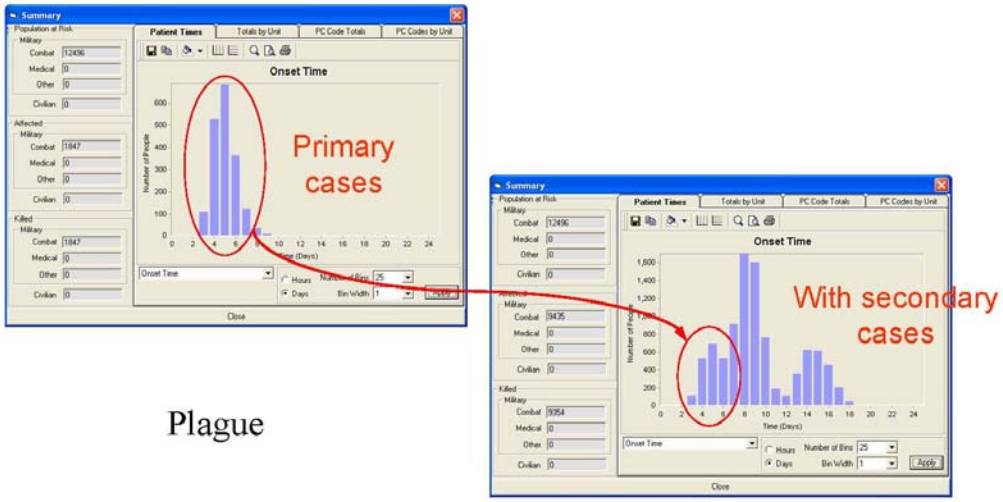


# *Patients Are Tracked By Deployed Unit and by DMSB Patient Condition*






## *NBC CREST Has a Secondary Infection Capability*




Plague

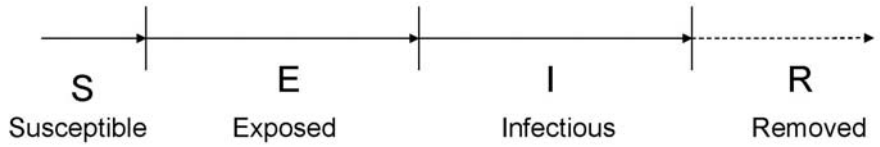


## *Secondary Infection in NBC CREST is an Implementation of the Methodology of AMedP-8*

- Calculate the primary infections from direct exposure to the delivered agent
- Use those primary cases as index cases in a SEIR epidemiological model provided by the Institute for Defense Analyses (Bombardt, 2001)
- Secondary cases follow pattern of historical outbreaks.

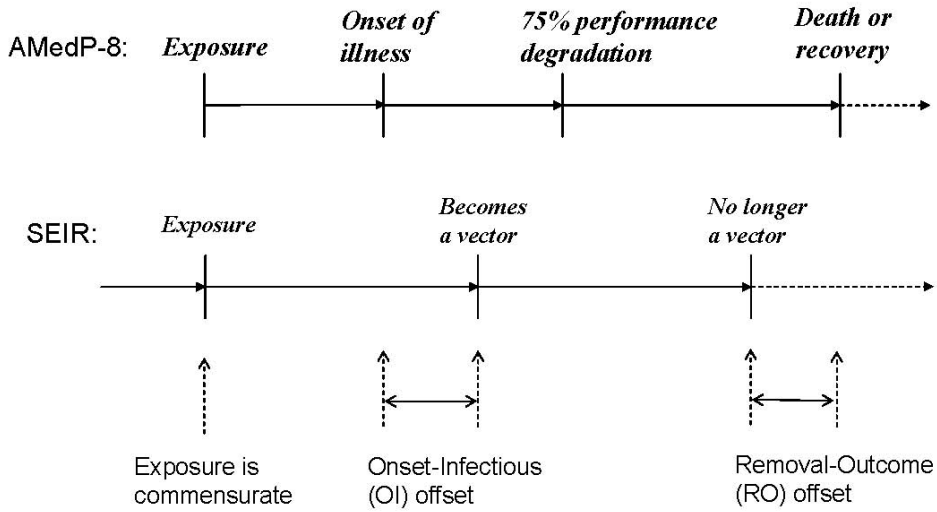
## *SEIR Algorithms Use Population Compartments*

- An individual moves sequentially through compartments:
  - S – Susceptible to disease (not yet infected)
  - E – Exposed and infected; initially asymptomatic
  - I – Infectious (able to communicate disease to others whether symptomatic or not)
  - R – Removed epidemiologically (not able to infect others)






## *Relate AMedP-8 and SEIR Timelines for an Individual*

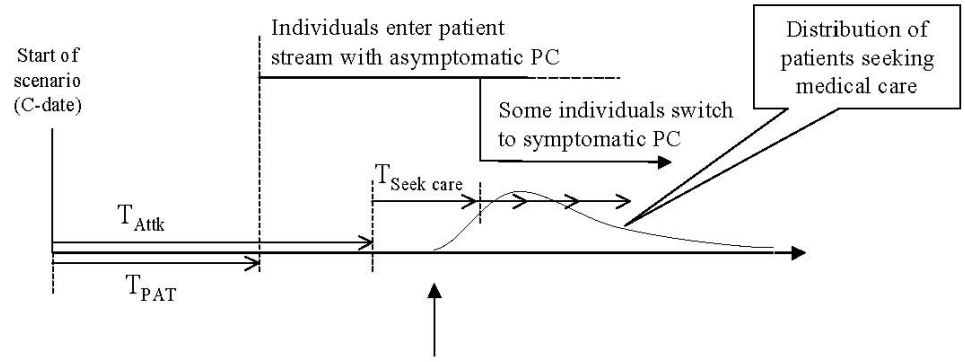


## *Antibiotic Prophylaxis and Vaccination*

- Strictly speaking, prophylaxis includes any pre-symptomatic medical countermeasure
- As a practical matter, the NBC CREST software separates vaccination and antibiotic prophylaxis
- Model limitations
  - Assumes that vaccination occurs prior to the scenario
  - Both are limited by the availability of treatment protocol data



## *Timing is Complex for Antibiotic Prophylaxis*




P(infection | with prophylaxis) = P(infection | no prophylaxis)*[1 – (effectiveness of prophylaxis)]

## *Medical Protection from Vaccination is Modeled with a Dose-independent Efficacy*

- Start with dose-response for unvaccinated individual
  - If not infected, then no change
  - If infection is indicated, use vaccine efficacy to decide whether protected
  - If not assign, patient condition accordingly
- Caveats
  - Tularemia data from human trials shows that vaccine efficacy is dose-dependent
  - Only anthrax and smallpox vaccines are currently available
  - Presently no doctrinal sources for vaccine efficacy



## *Medical NBC Casualty and Resource Estimation Support Tool (NBC CREST)*

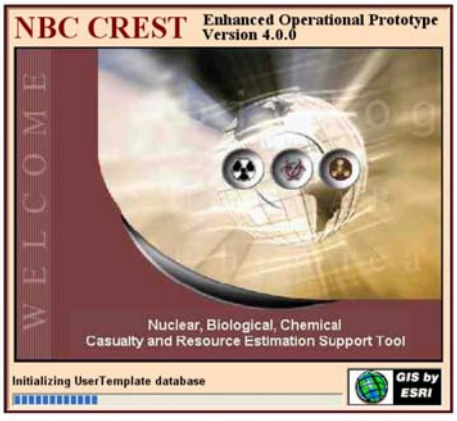
- Provides a detailed picture of time-dependent CBRN casualties and patients
- Includes treatment protocols and outcomes
- Provides basic models for prophylaxis and vaccination

# *BACKUP SLIDES*

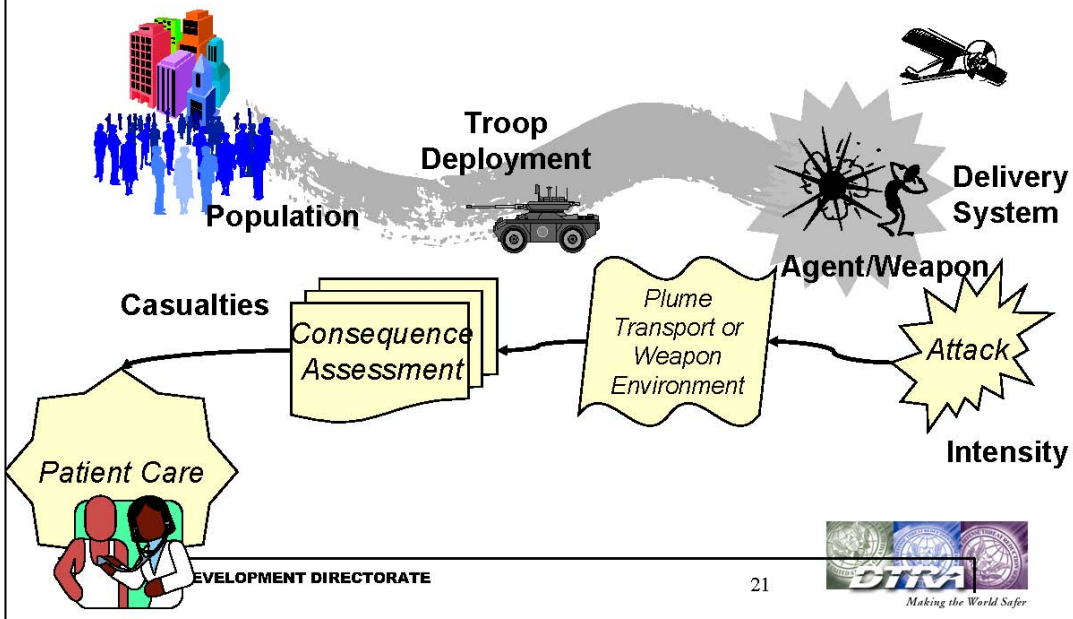


## *Medical NBC Casualty and Resource Estimation Support Tool (NBC CREST)*

- Originating Agency:
  U.S. Army
  Office of The Surgeon General
  Health Care Operations
  NBC Defense Staff Officer
- Transition Partner:
  DTRA
  Nuclear Technology Directorate

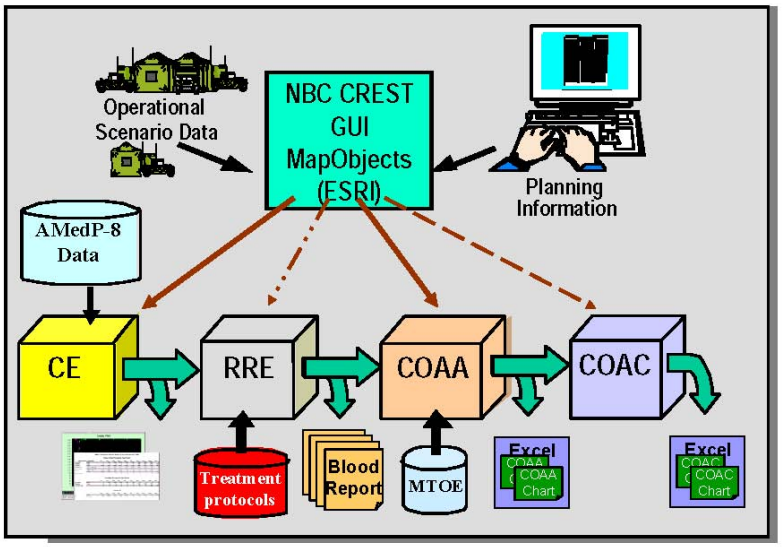


## *Consequence Assessment Supports Deliberate Planning for NBC Medical Response*



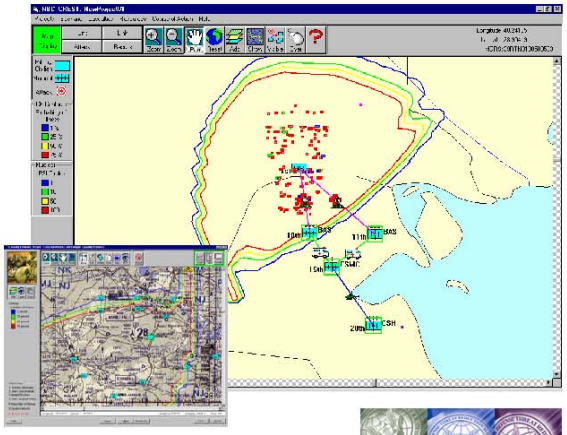



## *NBC CREST is Modular*



## *Casualty Estimation (CE) Module Supports User-defined Scenarios*

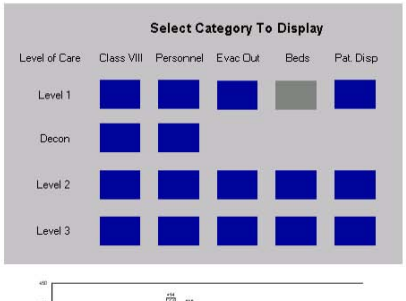
- Planner defines the NBC casualty/attack scenario in accordance with current threat and operational requirements
- Positions units or population on a map
- Adds network of Medical Treatment Facilities (MTFs)
- Chooses attacks
- Calculates casualties
- Saves patient stream

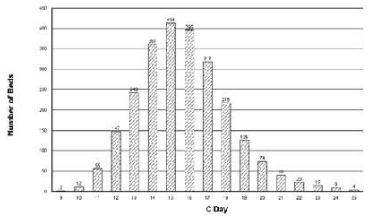




## *Resource Requirements Estimator (RRE) Tallies Logistical Requirements*

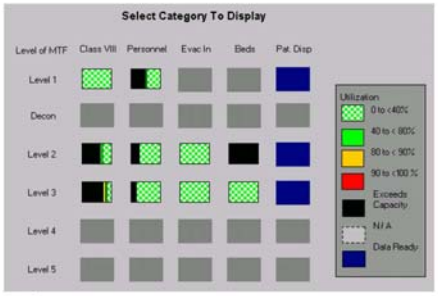
- Patient stream from the Casualty Estimator
- Medical Task-Time-Treater data from the Defense Medical Standardization Board (DMSB)
  - Class VIII materiel
  - Medical personnel
  - Beds
  - Evacuation assets
  - Decontamination assets
- Creates time-phased reports of medical resource requirements

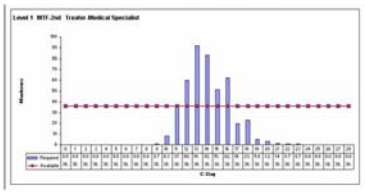


## *Course of Action Analysis (COAA) Module Assesses Medical Care Delivery*

- Compare Medical Treatment Facility (MTF) resources to requirements
- Highlight shortfalls
- Present results graphically
- Planner iterates to mitigate shortfalls



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## 2. Medical Surveillance System (MSS) – Briefing

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# Medical Surveillance System & Medical Information Technology Thrust Areas

Rashid A. Chotani, MD, MPH, DTM&H
Angel A. Fitzgerald, BChE, MS

*Chemical and Biological Defense Directorate*
*Joint Science and Technology Office*
Defense Threat Reduction Agency

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## Introduction

- Information Systems Capability Area in line with the current Joint Effects Model (JEM), the Joint Operational Effects Federation (JOEF), and the Joint Warning and Reporting Network (JWARN) requirements had initiated a new thrust area entitled Medical Surveillance System.
- This area combines *modeling and simulation support*, *medical surveillance* and *early warning system* for the warfighter.
- These three topics have been identified among the 392 gaps that are warfighter centric



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# 329 Gaps ONLY WARFIGHTER CENTRIC

**Medical Surveillance System**

| | | |
|---|---|---|
| 1 | Integrated Early Warning | 343.8685 |
| 2 | Biological Standoff Detection | 341.767 |
| 3 | Chemical Standoff Detection | 318.1199 |
| 4 | NBC Reconnaissance | 317.2976 |
| 5 | Respiratory and Ocular protection | 316.1314 |
| 6 | Individual Decontamination | 313.5884 |
| 7 | Percutaneous Protection | 309.9146 |
| 8 | Biological Prophylaxis | 305.028 |
| 9 | Medical Therapeutics Biological | 301.7796 |
| 10 | Radiological Standoff Detection | 301.1942 |
| 11 | Medical Therapeutics Chemical | 300.4271 |
| 12 | Medical Surveillance | 299.7328 |
| 13 | Battle Management Systems | 298.3846 |
| 14 | Biological Point Detection | 294.6194 |
| 15 | Chemical Prophylaxis | 287.5636 |
| 16 | Equipment Decontamination | 284.8345 |
| 17 | Chemical Point Detection | 283.7092 |
| 18 | Expeditionary COLPRO | 279.2838 |
| 19 | Fixed Site COLPRO | 273.8676 |
| 20 | Medical Diagnosis | 271.821 |
| 21 | Battle Analysis | 270.7538 |
| 22 | Sensitive Equipment Decontamination | 264.5109 |
| 23 | Radiological Point Detection | 261.3473 |
| 24 | Medical Therapeutics Radiological | 239.3276 |
| 25 | Radiological Prophylaxis | 237.1608 |
| 26 | Modeling and Simulation Support | 233.3569 |
| 27 | Fixed Site Decontamination | 225.1929 |



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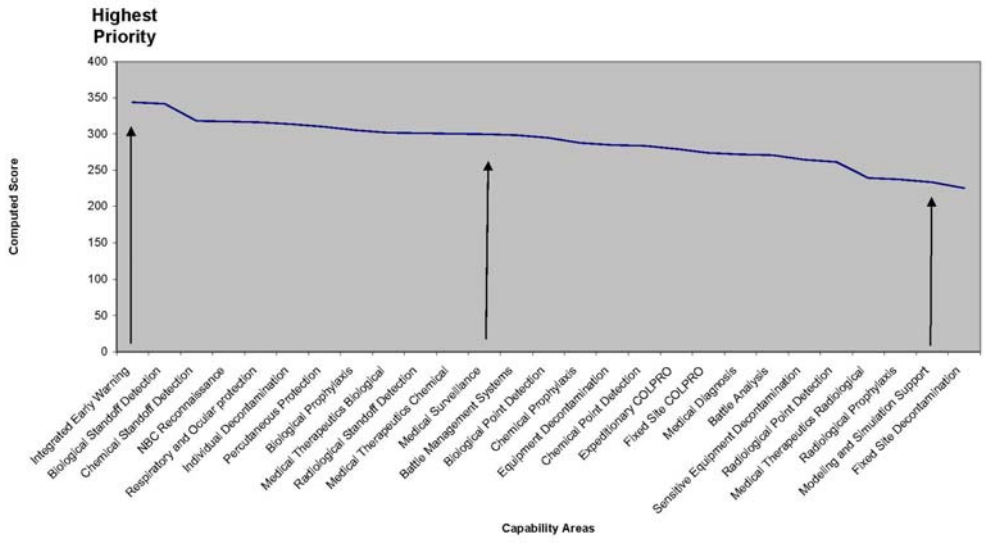
# Capability Area Prioritization Based on PD Gaps



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# MISSION

- To minimize warfighter casualty due to infectious diseases, in particular biological WMDs.





# OBJECTIVES

**The main objective is to combine modeling/simulation, medical surveillance, early warning detection and real-time epidemiology to develop technologies and models that can identify:**

- **Anomalies related to infectious diseases in warfighter (and civilian populations if data is available) in-theater using bio-surveillance and early detection models;**
- Predict bio-threat agent based casualties (morbidity & mortality) in-theater; taking into account multiple variables such as wind, humidity, transmissibility/infectivity/case fatality ratios, availability of effective countermeasures, public health measures to apply countermeasures, etc;
- Predict the risk of acquiring naturally-occurring infectious diseases based upon knowledge of endemnicity of the circulating pathogen in geographically strategic warfighting areas utilizing climate data, remote sensing etc.

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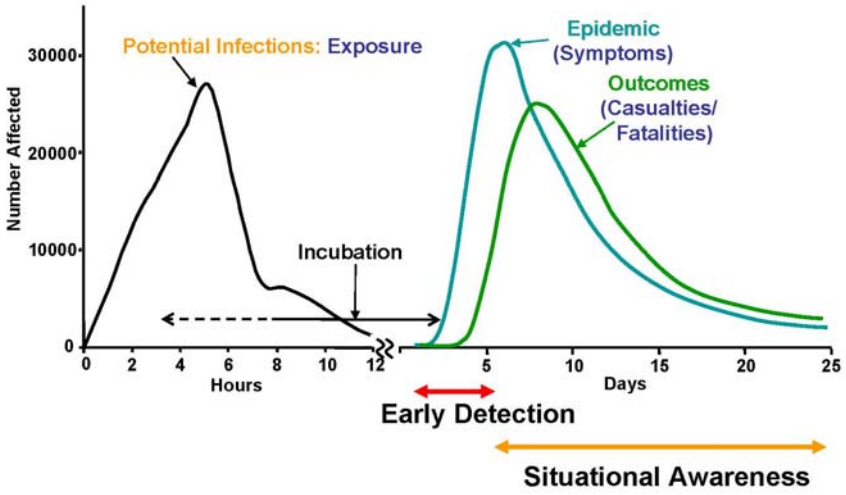
# Early Event Detection and Situational Awareness

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# PLAN

**The plan is divided into three distinct areas which will assist the government not only embark on novel technologies but to evaluate, validate, support and assist in integration of existing initiatives.**

1. ***Evaluation & Validation***
2. ***Support Novel and Existing Technologies***
3. ***Integration***



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## Evaluation & Validation

- **Currently multiple early or rapid detection of agents of interest (biosurveillance systems) are being funded by the DOD.**
- Each program uses multiple data sources, different variables and methodologies.
- These systems have been utilized during various large scale public events including the 2004 Presidential Inauguration, the Super Bowl, and the Olympics.
- Each biosurveillance program might be unique but very little information exists regarding independent validation within (sensitivity/specificity) and among (between systems) these programs.
- In order to address the JOEF, JEM & JWARN requirements it is imperative to first evaluate the science, identify and review the various biosurveillance modeling systems and then validate them to illustrate strengths, weaknesses and synergies between systems.






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## Support Novel and Existing Technologies

- **Support the Chem/Bio Directorate and existing programs within DOD (eg. EOS), DTRA (IDAC, ARGUS), DHS (eg. NBIS) or DHHS to enhance their capabilities.**

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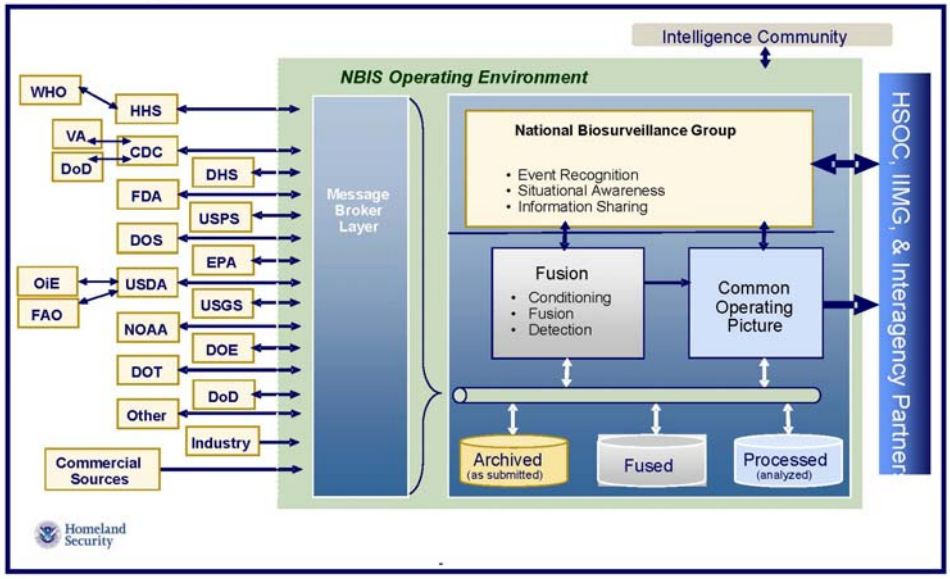
# NBIS IT System Concept

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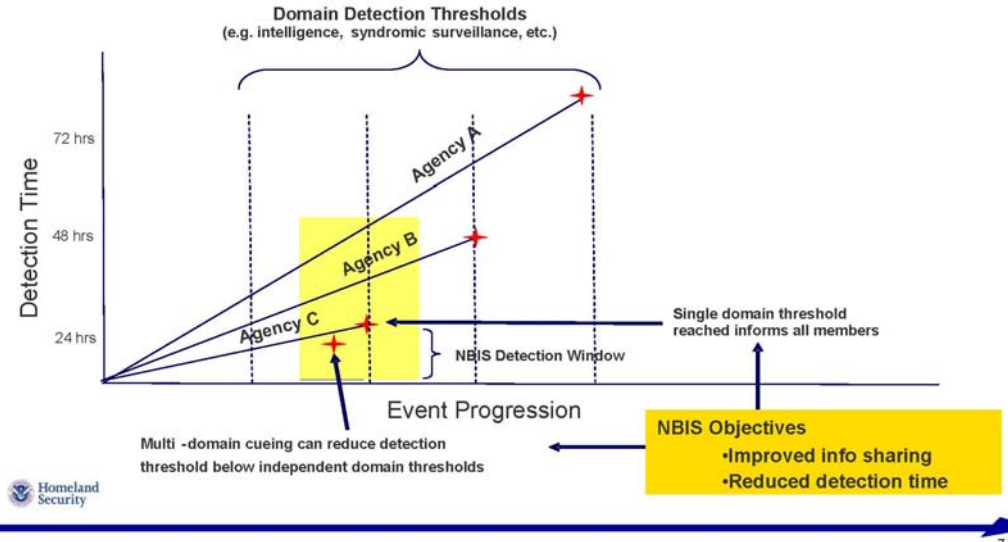
# Enhanced Surveillance

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## Predicting Effects Due to Infectious/Contagious Diseases for JEM

- **Objective:**
  - Provide a well-founded model for casualty estimates in JEM involving infectious/contagious diseases, both bioagent-induced and naturally occurring.
- **Effort:**
  - The team will extend homogeneous mixing models for secondary infection with plague, smallpox, and influenza to account for heterogeneous mixing among sub-populations and predict the spread of disease among interacting populations for use in JEM.



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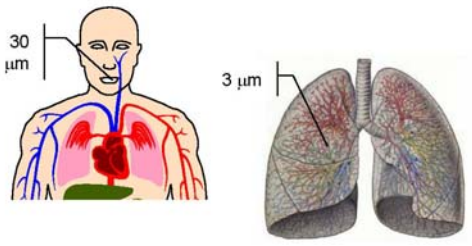
## Predicting Effects Due to Infectious/Contagious Diseases for JEM

- **Benefits of Proposed Technology:**
  - Provide more realistic casualty estimates for contagious diseases, both bioagent-induced and endemic; maintain consistency with modeling by DHHS/NIH.
- **Challenges:**
  - Establish a computationally fast-running alternative to agent-based models like EpiSim
  - Validation of the model with real-world data, detailed models, and subject matter expertise
- **Maturity of Technology:**
  - Homogeneous mixing models have been demonstrated in NBC CREST; TRL 4.

## Medical Information Technology Thrust Area

**Goal:** Develop the tools and modules to provide casualty estimation and prediction of human performance in hazard environments for the Joint Operational Effects Federation (JOEF).


**Benefit to warfighter:** Provide increased awareness of medical impacts on warfighters to decision makers to allow for informed planning.








## NBC CREST Transition to JPM-IS

- **Objective:**
  - **Prepare casualty estimation and medical planning technology in the medical NBC CREST deliberate planning tool for transition to JPM-IS in support of JOEF Increment I.**
- **Effort:**
  - **NBC CREST human response models for CBRN agent exposure, based on NATO's Allied Medical Publication 8 (AMedP-8), will be implemented in an object-oriented form for transition to JPM-IS. Software will be tested, verified, validated, and documented for transition. The NBC CREST stand-alone version will be verified and validated for application by JPM-IS.**

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## NBC CREST Transition to JPM-IS

- **Benefits of Proposed Technology:**
  - NBC CREST medical planning technology contributes time-dependent human response models to JOEF for estimating the task effects of CBRN exposure and for estimating the patient streams.
  - The medical resource requirement estimates and medical course of action analysis of NBC CREST provide medical-related MOP/MOEs for JOEF.
- **Challenge:**
  - Achieving a broad-based validation process
- **Goals/Milestones:**
  - Transition present AMedP-8 chemical and biological models from NBC CREST to JOEF; Verify NBC CREST 5.0 for utilization by JPM-IS
  - Transition TIC/TIM and AMedP-8 nuclear models from NBC CREST to JOEF
  - Transition long-term radiological effects models to JOEF; provide V&V documentation for all transitioned CBRN human response models

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## Medical Modeling of Particle Size Effects for Inhalation Hazards

- **Objective:**
  - Develop medical models for the influence of aerosol particle size on the health effects of inhaled CBRN hazards to improve hazard assessment, particularly in urban environments.
- **Effort:**
  - Link existing models of the respiratory tract and of the particle size distribution (PSD) of atmospheric aerosol hazards to estimate location of inhaled CBRN agent deposition in the body. The Team will quantify the dependence of the health effects of the agents on deposition site. Models will be implemented and tested in coordination with JSTO and JPM-IS for transition to Programs of Record.

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# Medical Modeling of Particle Size Effects for Inhalation Hazards

- Benefits of Proposed Technology:
  - Will enhance the fidelity of CBRN health effects in modeling and simulation tools such as JEM, JOEF, and NBC CREST, for casualty estimation and medical planning. Particle size effects are expected to be especially significant in urban areas and in building interiors.
- Challenges:
  - Gathering sufficient data on the PSD dependence of health effects for a wide range of CBRN agents.
- Maturity of Technology:
  - TRL 6 - Respiratory tract models.
  - TRL 3 – PSD-dependent disease models.

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# Comments & Suggestion

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## 3. Joint Operational Effects Federation (JOEF) - Briefing

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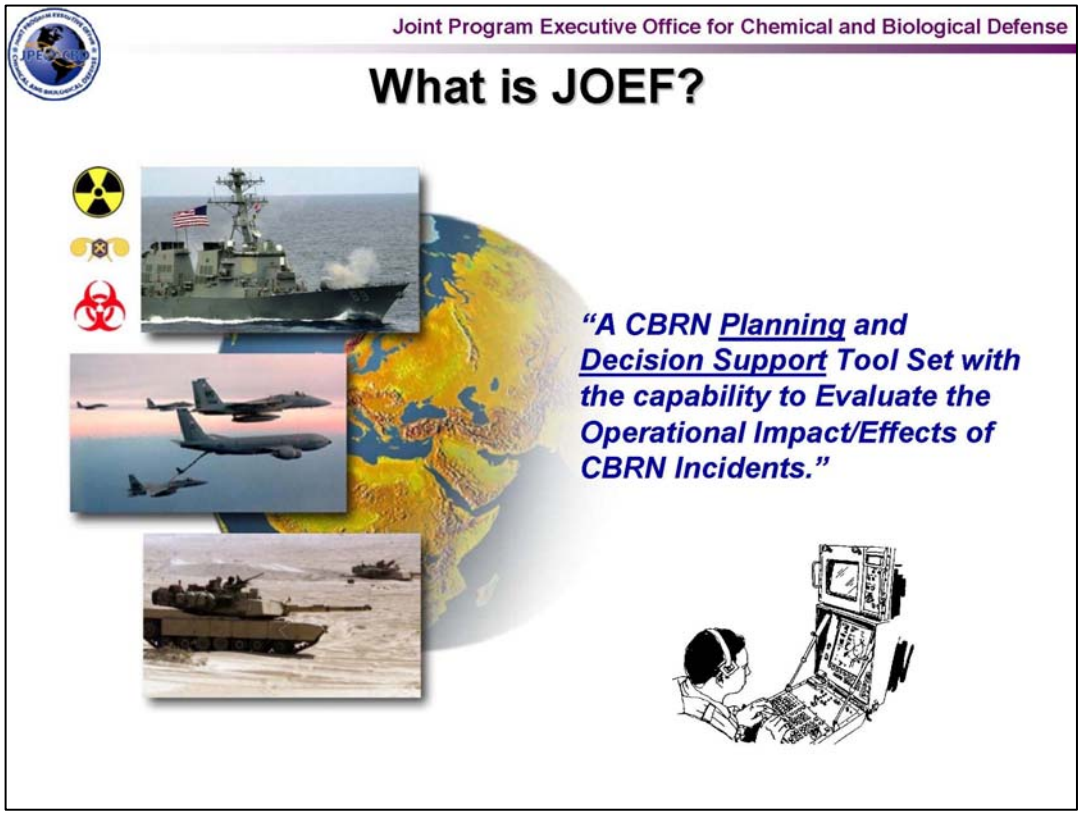
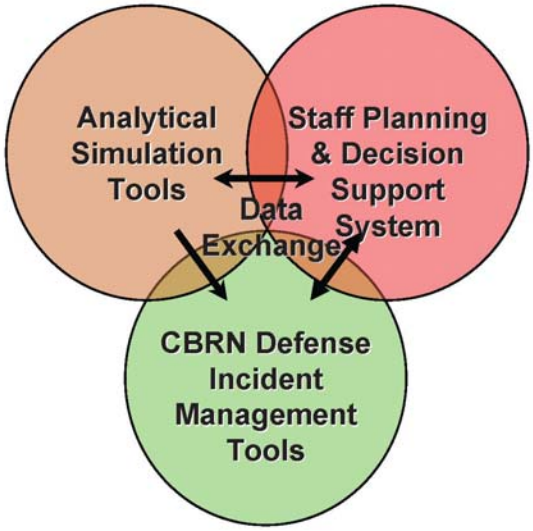
JPEO-CBD
The Joint Operational Effects Federation (JOEF):
A joint Chem-Bio Automated Decision Support Tool For Deliberate and Crisis Action Planning and Decision-Making


Joint Program Executive Office for Chemical and Biological Defense
What is JOEF?
"A CBRN Planning and Decision Support Tool Set with the capability to Evaluate the Operational Impact/Effects of CBRN Incidents."

# JOEF Overview



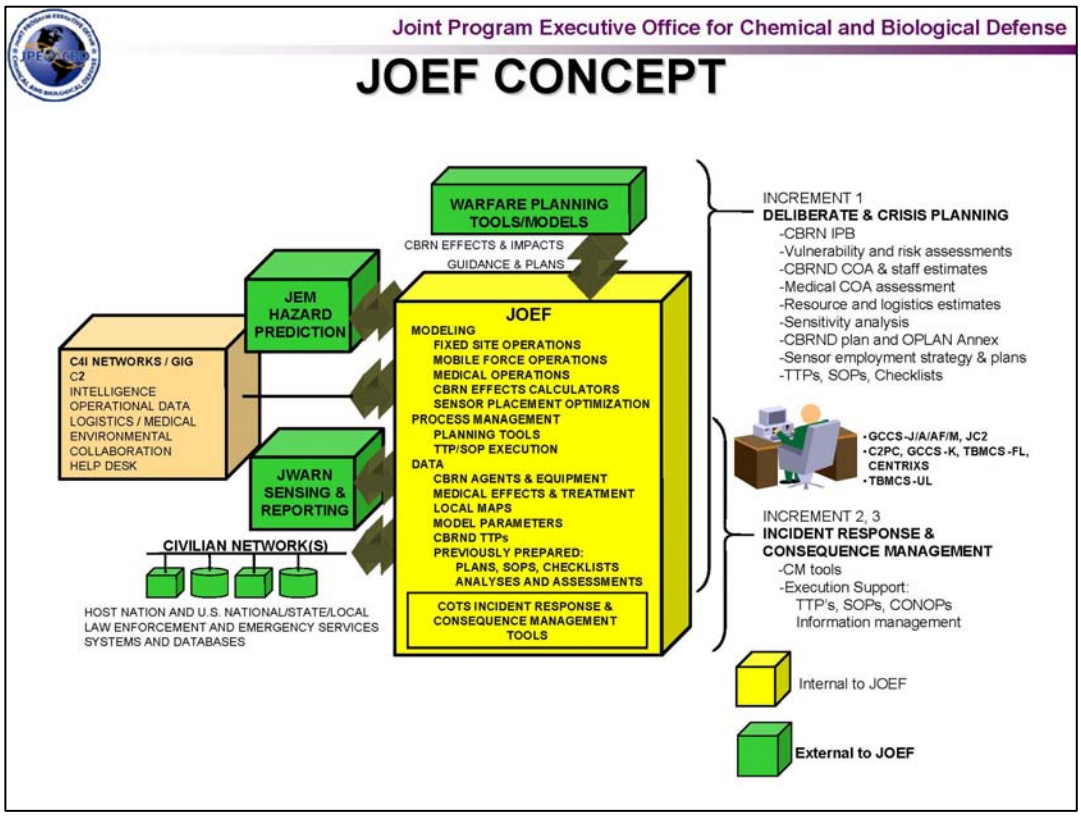

## JOEF Requirements include:

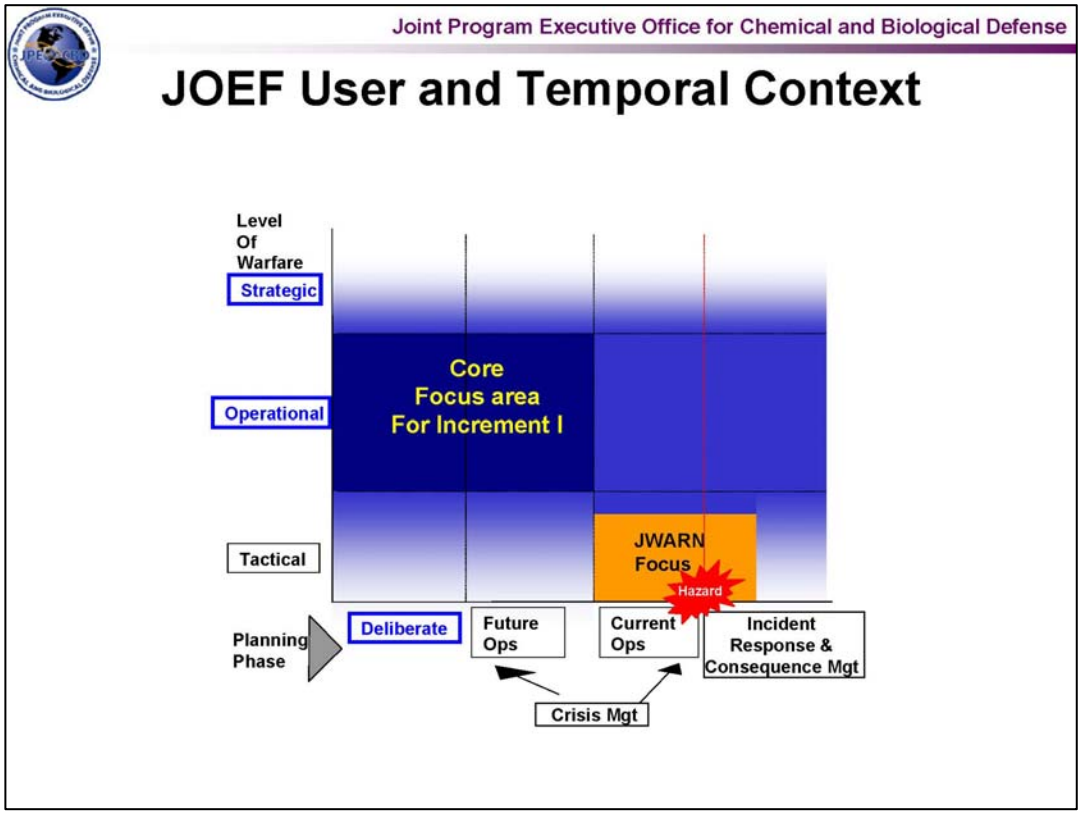
- Deliberate planning tool
- Operational Effects Prediction Tool
- Decision Support tool for Consequence Management
- COE and NCES Compliance & Interoperability with external systems
- Net Ready – A Joint integrated architecture

Joint Program Executive Office for Chemical and Biological Defense

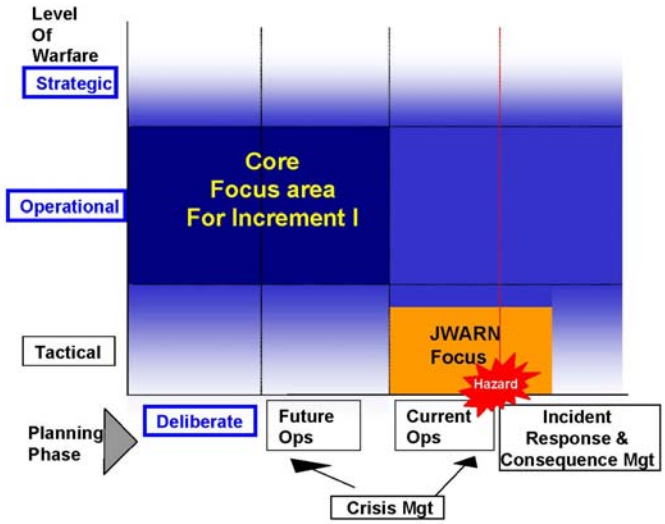
# JOEF Increments Summary

| JOEF Inc | User Level | Deliberate Planning C4ISR Environment | Crisis Planning C4ISR Environment | Incident Response & Consequence Management Site | Incident Response & Consequence Management C4ISR Environment |
|---|---|---|---|---|---|
| I | Strategic | COE/C2PC | | | |
| | Operational | COE/C2PC | COE/C2PC | | |
| | Tactical | | | | |
| II | Strategic | Standalone | COE/C2PC Standalone | Military | COE/Standalone |
| | Operational | Standalone | Standalone | | |
| | Tactical | COE/C2PC Standalone | COE/C2PC Standalone | | |
| III | Strategic | | | Civilian | COE/Standalone |
| | Operational | | | | |
| | Tactical | | | | |


Joint Program Executive Office for Chemical and Biological Defense
JOEF CONCEPT
WARFARE PLANNING TOOLS/MODELS
CBRN EFFECTS & IMPACTS
GUIDANCE & PLANS
JEM HAZARD PREDICTION
C4I NETWORKS / GIG
C2
INTELLIGENCE
OPERATIONAL DATA
LOGISTICS / MEDICAL
ENVIRONMENTAL
COLLABORATION
HELP DESK
JWARN SENSING & REPORTING
CIVILIAN NETWORK(S)
HOST NATION AND U.S. NATIONAL/STATE/LOCAL LAW ENFORCEMENT AND EMERGENCY SERVICES SYSTEMS AND DATABASES
JOEF
MODELING
FIXED SITE OPERATIONS
MOBILE FORCE OPERATIONS
MEDICAL OPERATIONS
CBRN EFFECTS CALCULATORS
SENSOR PLACEMENT OPTIMIZATION
PROCESS MANAGEMENT
PLANNING TOOLS
TTP/SOP EXECUTION
DATA
CBRN AGENTS & EQUIPMENT
MEDICAL EFFECTS & TREATMENT
LOCAL MAPS
MODEL PARAMETERS
CBRND TTPs
PREVIOUSLY PREPARED:
PLANS, SOPS, CHECKLISTS
ANALYSES AND ASSESSMENTS
COTS INCIDENT RESPONSE & CONSEQUENCE MANAGEMENT TOOLS
INCREMENT 1
DELIBERATE & CRISIS PLANNING
-CBRN IPB
-Vulnerability and risk assessments
-CBRND COA & staff estimates
-Medical COA assessment
-Resource and logistics estimates
-Sensitivity analysis
-CBRND plan and OPLAN Annex
-Sensor employment strategy & plans
-TTPs, SOPs, Checklists
•GCCS-J/A/AF/M, JC2
•C2PC, GCCS-K, TBMCS-FL, CENTRIXS
•TBMCS-UL
INCREMENT 2, 3
INCIDENT RESPONSE & CONSEQUENCE MANAGEMENT
-CM tools
-Execution Support:
TTP's, SOPs, CONOPs
Information management
Internal to JOEF
External to JOEF


Joint Program Executive Office for Chemical and Biological Defense
JOEF User and Temporal Context
Level Of Warfare
Strategic
Operational
Tactical
Core Focus area For Increment I
JWARN Focus
Hazard
Planning Phase
Deliberate
Future Ops
Current Ops
Incident Response & Consequence Mgt
Crisis Mgt

# JOEF User and Temporal Context

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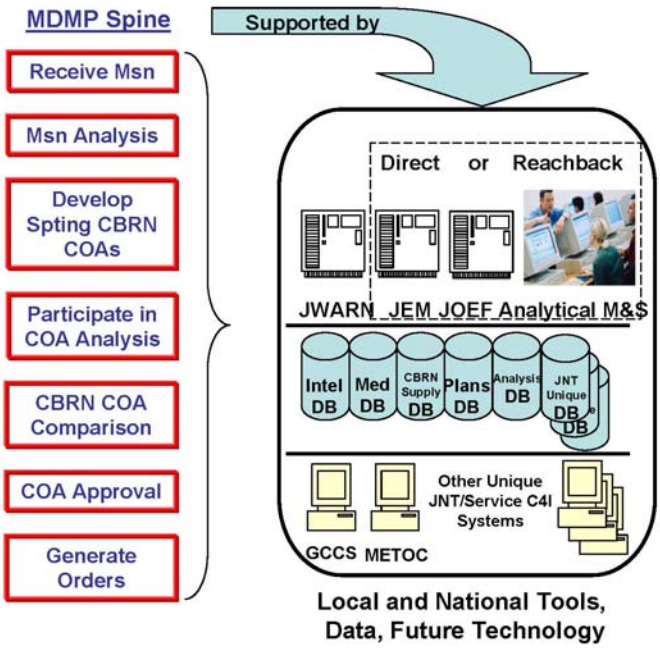
**Increment I:**

**(Before the CBRN Event)**

**Deliberate Planning**
**Crisis Planning**

## MDMP-The Spine of JOEF

- JOEF system spine – the military decision-making process (MDMP)
- Connectivity
  - C4I systems and databases
  - METOC
  - Staff sections
  - Reachback to centers of excellence
  - JWARN
  - JEM
- Attached tried and proven tools and technologies
- Inclusion of future technologies




Joint Program Executive Office for Chemical and Biological Defense

## Support to CBRN Planning

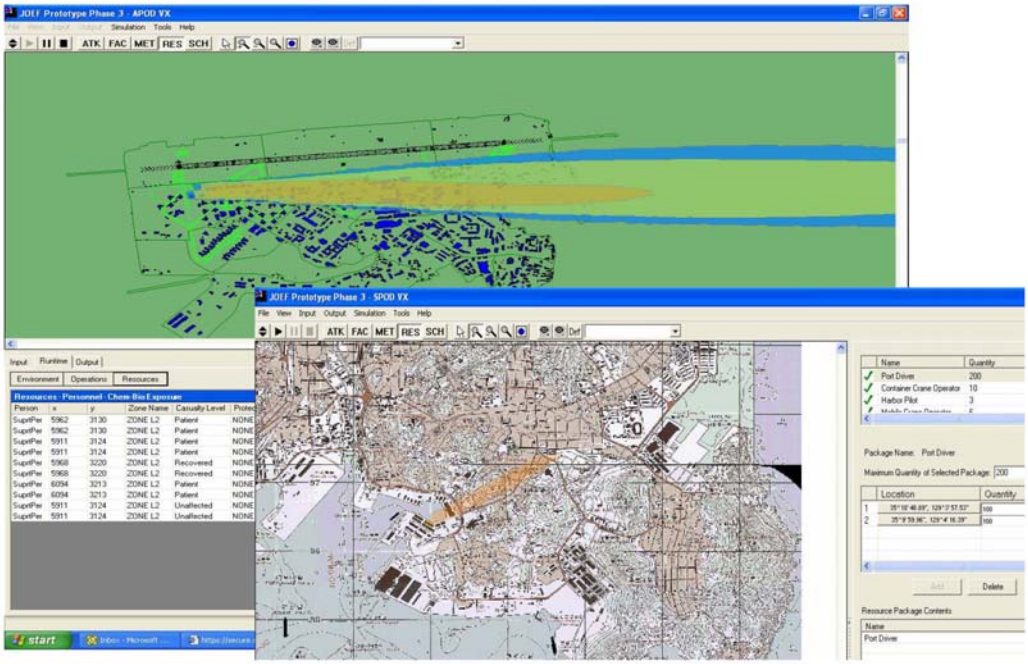
### Workflow Management

- Workflow Manager (WFM) module semi-automates and manages the multi-step processes used to produce various planning products such as Plans, Reports, and Assessments

### Activity Automation

- Activity Automation (AA) Module semi-automates the creation of individual work products for tasks defined in a JOEF Workflow Manager process model

# Analytical Simulation Tools



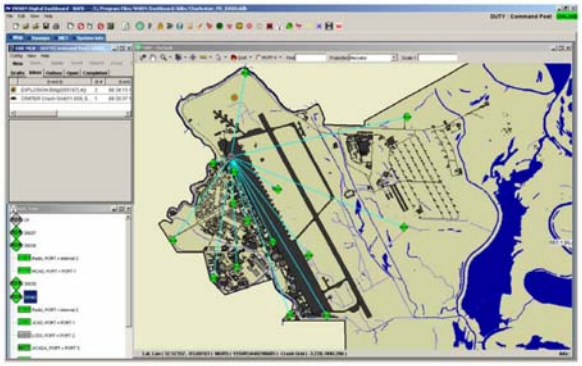

Joint Program Executive Office for Chemical and Biological Defense

**Increments II and III:**

**(CBRN Event)**

**Incident Response &**
**Consequence Management**
**(Military, Civilian)**

# JOEF Consequence Management



| CHART | Light Work Level | | |
|---|---|---|---|
| | Risk Assessment of Nerve Agent Exposure and Effect | | |
| | Threshold Risk (Th) | Incapacitation Risk (EC) | Lethal Risk (LC) |
| Risk @ Calculated Dosage | <16% | <16% | <16% |
| Dose Required for Percentile Response | Th16 Dose (mg-min/M3) 0.2725 | EC16 Dose (mg-min/M3) 19.96 | LC16 Dose (mg-min/M3) 28.89 |
| Calculated Dosage (mg-min/M3) | 0.2700 | 0.2700 | 0.2700 |
| | Moderate Work Level | | |
| | Risk Assessment of Nerve Agent Exposure and Effect | | |
| | Threshold Risk (Th) | Incapacitation Risk (EC) | Lethal Risk (LC) |
| Risk @ Calculated Dosage | 17%-18% | <16% | <16% |
| Dose Required for Percentile Response | Th04 Dose (mg-min/M3) 0.2506 | Th16 Dose (mg-min/M3) 9.93 | Th16 Dose (mg-min/M3) 14.44 |
| Calculated Dosage (mg-min/M3) | 0.2700 | 0.2700 | 0.2700 |
| | Heavy Work Level | | |
| | Risk Assessment of Nerve Agent Exposure and Effect | | |
| | Threshold Risk (Th) | Incapacitation Risk (EC) | Lethal Risk (LC) |
| Risk @ Calculated Dosage | 20% | <16% | <16% |
| Dose Required for Percentile Response | Th04 Dose (mg-min/M3) 0.1957 | Th16 Dose (mg-min/M3) 6.62 | Th16 Dose (mg-min/M3) 9.63 |
| Calculated Dosage (mg-min/M3) | 0.2700 | 0.2700 | 0.2700 |

- General Purpose CM tools, plus user-specific tools
  - General Purpose Tools: GIS interface, maps, geo-spatial analysis capabilities
  - User-Specific Tools: Sweep tools, CHART, ChemRat, etc.

Joint Program Executive Office for Chemical and Biological Defense

# Automated Coalition Consequence Management (ACCM) Advanced Technology Demonstration (ATD)

- *Proposed* ATD which will provide Web-based CBRN planning and CM capabilities to a coalition of 33 Pacific Rim countries
- Key to the ACCM consequence management capabilities are human effects and medical resource modeling capabilities

# Contact Info

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# F. DETERMINING HUMAN RESPONSE MODEL ATTRIBUTES

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1. **Determining CBRN Human Response Models Attributes - Briefing**

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Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882

# Determining CBRN Human Response Models Attributes

Carl A. Curling, Sc.D.
Lusine Danakian
Deena S. Disraelly
Julia K. Burr
Terri Walsh
Margaret Porteus
Bob Zirkle

**Institute for Defense Analyses**
December 4, 2006

## Human Response Models Today

- Human response models describe the nature, severity and timing of human response to CBRN insults
  - Some components may be dose-dependent
- Current human response models used by DoD are:
  - Probit models
  - Performance-based models (Intermediate Dose Program methodology)
  - Toxic load model

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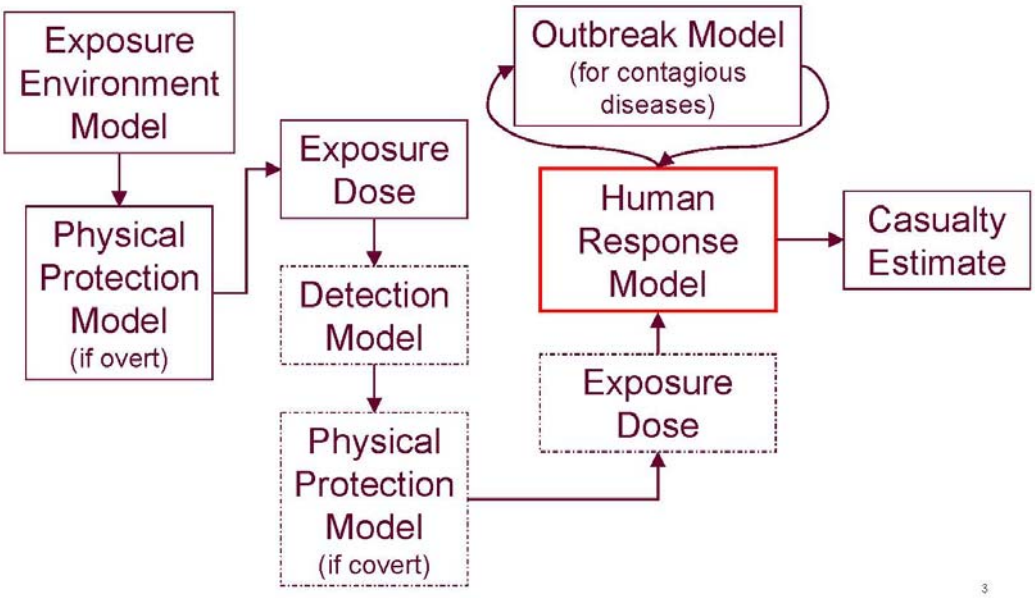
## Application of Human Response Model: AMedP-8

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## Human Response Models in the Future

New Models are Needed

- New Threats
  - TICs/TIMs
  - RDDs
  - Pandemic Influenza
- New Missions
  - Installation Security
  - Consequence Management
- New Requirements
  - Higher standard of care = New definition of casualty
  - Civilian population at risk

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## Process Impetus

- NATO
  - While accepting of the current manual on the estimation of Nuclear, Biological, and Chemical casualties, NATO members desire to update the models and increase the utility of the Standardization Agreement.
- JOEF
  - The next generation of models which estimate the operational impact of CBRN agents MUST have a human response model that is accredited by DoD and accepted by the user community.
- BioShield
  - The direction to DHHS to develop a stockpile of material for national response to CBRN disasters raises the requirement for a nationally accepted model of civilian response to CBRN events.

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## Process Scope

- NATO
  - NATO Allies define the scope of the desired Standardization Agreement to address classical NBC warfare agents, TICs/TIMs, RDDs, Pandemic Influenza, and emerging threats. AMedP-8 must address a wide range of military operations, for units from squads to Allied Task Force.
- JOEF
  - JOEF establishes the acquisition parameters for development of a new suite of tools, without defining the attributes of the human response model desired by the user community.
- BioShield
  - DHHS recognizes a requirement to estimate civilian response to CBRN events that is acceptable to cities, states, and the Interagency.

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## Process Scope

- Questions divided into six broad topics
  - Users And Uses
  - Inputs known to the users
  - Output desired by the users
  - Time dimensions appropriate to the task
  - Model Methodologies to be considered
  - Tool / Application properties desired by the user

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## Interview Process

- Military
  - COCOMs
  - Joint Staff
  - Service Staffs
  - Support Staffs
  - Research Institutes
- Civilian
  - Federal
  - Local
- Allied
  - NATO CBRN Med WG

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## Interviewees

| | | | |
|---|---|---|---|
| AFRRI | DTRA | Army OTSG | DOT |
| AFIOH) | FFC | PACOM | DOT Safety Admns |
| AMEDDC&S | RSO Norfolk | USARPAC | FAA |
| ASBP | NMCO/RSO Norfolk | 13 AF | FEMA |
| CASS | JFCOM | COMPACFLT | BPHC |
| CENTCOM | MARFORCOM | SOCPAC | Boston EMS |
| AFRL | NECC | USAFSAM | LA County Emerg Prep |
| CHPPM | RIVGRU ONE | USAMRICD | LA County PH |
| ECBC | C2F | USAMRIID | LA County DMH |
| DTRA | JRO | USFORSCOM | LAWA |
| BuMed | JTF-CS | ARCENT | SD Emerg Prep |
| USANCA | 3rd Fleet | Third Army | NYC OEM |
| JRO | NEPMU-5 | CCID/NCID | NYPD |
| ARA | NHR | COTPER | NYC DoT |
| NSW | NMCSD | COGH/OGPSS | NY/NJ Intel |

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## Interviewees

- 60 Organizations
- More than 190 people
- Military
  - Army, Navy, Air Force
  - JRO, DTRA, AFRRI
  - CENTCOM, PACOM, JFCOM
- Civilian
  - CDC, DOT, FEMA, FAA
  - Boston, New York, San Diego, Los Angeles

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## Responses

- Analyzed in groups
  - Military – Operational
  - Military – Support
  - Civilian
- Responses within groups collated for consensus and divergence
- Collated group responses further collated for consensus and divergence

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## Results

- USERS and USES
  - Military
    - Operational Planners – Personnel (G-1), Operations (G-3), Logistics (G-4), Surgeon
    - Garrison and hospital planners
    - Staff scientists/ researchers
    - Modelers
  - Federal
    - DOT, FEMA, NIOSH, National Labs
  - Local
    - Departments of Public Health and Mental Health
    - Emergency Management Departments
    - EMS
    - Fire Departments
    - Environmental Health and Protection

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## Results

- INPUTS
  - **Agents**
    - Priority to warfare agents
    - CDC Category A
    - TICS/TIMS/INDs
    - Naturally occurring and emerging diseases
    - Explosives
    - Hurricanes and other natural disasters
    - Rad & Nuc – particularly due to location (i.e. near a nuclear power plant or a Naval nuclear aircraft carrier base)
  - **Exposure routes …**
  - **Population at risk …**
  - **Population demographics …**
  - **Medical protection …**
  - **Technical detection and/or surveillance (external) …**
  - **Treatment (external) …**
  - **Additional Parameters to consider …**

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## Results

- OUTPUTS

Simplistically: If X exposure, you'll get Y effect at Z time

Outputs should help make decisions – should be reliable and actionable

- Number, location and time phase of
  - Exposed
  - Health status
  - Outcome
  - Unit operational capability
- Med Mgmt Model
  - Med countermeasures
  - Med care and resources required
- Epi Estimates
- Sensitivity Analysis
- Confidence
- Behavioral response

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## Results

- TIME
  - The issue of time and time intervals will likely be mission dependent
  - The start of the timeline … Time=0
  - The length of the timeline will depend on
    - Agent
    - Dose (Chronic vs. acute)
    - Impact of intervention over time
    - The model should allow for consideration of consider acute, latent and chronic effects
  - The end of the timeline – until response is no longer necessary
    - User defined, within specified parameters
  - Report in minutes/hours for early effects, days/weeks for later effects
  - End no earlier than 72 hours, or as late as until recovery (lifetime?)
  - Time of day and year was noted as a factor that can alter triage and treatment protocols, as well as population at risk

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## Results

- METHODOLOGY
  - The methodology must include what is appropriate for the agent, population and response being modeled
    - Estimates of casualties and fatalities are necessary but not sufficient
    - Time dimension of human response must be considered
    - Duration of exposure should be considered as appropriate
    - Capability should be represented
    - Nature and severity of signs and symptoms should be captured

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## SCOPE

- Should time be a factor in the model?
- Should time be considered as an input?
  - What times are important to you as the user?
- Should time be considered as an output?
  - What time intervals should outputs be divided into? (Minutes? Hours? Days? Months?)
  - What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)

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## METHODOLOGY

- What methodology should be used in the human response model? Do you have a preference or recommendation?
  - Probit?
  - Performance-based?
  - Toxic load?
  - Other?
- How much insight would you require into the underlying methodology? Underlying data?
  - Completely transparent (algorithms)?
  - Black box?

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## APPLICATION/ TOOL

- What platform(s) should run this application?
- What interface should this application/tool use?
- What program(s) should the tool be compatible with?
- What format(s) should be used to present the outputs?

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## APPLICATION/ TOOL

- What level of training would you expect to receive for this tool/model?
- What level of support would your activity require for this tool/model?
- Are there others you recommend that we interview on this subject?

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## Contact

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## Process Scope

- NATO
  - NATO Allies define the scope of the desired Standardization Agreement to address classical NBC warfare agents, TICs/TIMs, RDDs, Pandemic Influenza, and emerging threats. AMedP-8 must address a wide range of military operations, for units from squads to Allied Task Force.
- JOEF
  - JOEF establishes the acquisition parameters for development of a new suite of tools, without defining the attributes of the human response model desired by the user community.
- BioShield
  - DHHS recognizes a requirement to estimate civilian response to CBRN events that is acceptable to cities, states, and the Interagency.

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## 2. USERS & USES Attributes - Briefing

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Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882

# Defining the Attributes of CBRN Human Response Models

# USERS & USES

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 4, 2006

## Sub-Task Objective

*Identify current and potential* USERS & USES *for CBRN Human Response Models.*

2

# USERS & USES

## *Consensus*

**In your organization, who currently uses human response models (either alone or within a suite of models)?**

- Model users include:
  - Personnel
  - Operations
  - Logistics
  - Surgeon and Public Health
  - Plans
  - Emergency management
  - Laboratories and research centers

3

# USERS & USES

## *Additional Considerations*

**In your organization, who currently uses human response models (either alone or within a suite of models)?**

Some sample users include:

- Incident Analysis Cell (IAC) modelers
- Garrison and hospital planners
  - Are trying to work together
- USAMRIID
- AFRRI
- USAFSAM
- AMEDD C&S
- CHPPM
- ECBC
- Navy Radiation Health
- DTRA
- USANCA
- DOT
- FEMA
- NIOSH
- National Labs
- Local Public & Mental Health
- Local Emergency Mngt
- Local Fire and EMS

4

# USERS & USES

## *Consensus*

**Are there others in your organization that could benefit from these models?**

- Yes, others could benefit
  - Operational
  - Strategic
  - Tactical
- Needs to be reliable, accessible, and affordable to be used at every level

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# USERS & USES

## *Additional Considerations*

**Are there others in your organization that could benefit from these models?**

***Military Operational***

- Almost all: J1, J2, J3, J5, J7, J8
  - Possibly civil affairs or security
  - National Guard

***Military Support***

- Researchers, scientists
- Doctrine developers (USAFSAM)
- Trainers, exercise designers
- Environmental & operational health experts
- Planners & managers

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# USERS & USES

## *Additional Considerations*

**Are there others in your organization that could benefit from these models?**

***Civilian***

- Public Health
- Emergency Operations and Emergency Management
- Fire and Police Departments
- EMS
- Intel, Terrorism and Early Warning groups
- HAZMAT personnel
- FEMA
- Transportation Departments
- Hospitals

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# USERS & USES

## *Consensus*

**Which models/ applications do they use? How often?**

- Models that are used with some regularity include:
  - Plume models and the associated casualty estimation tools are used by some during exercises and planning (i.e. HPAC, etc)
  - FluSurge has been used for planning and casualty estimation
  - Models not directly related to CBRN, including epidemiological models, resource tracking models, and logistics models (i.e. MAT)
- **Rules of thumb, best guess, and estimation** are commonly used
  - These may be based on SMEs, CDC or WHO guidelines, military documents, historical experience, or any other number of sources

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# USERS & USES

## *Consensus (cont'd)*

### Which models/ applications do they use? How often?

- Models are used, but often infrequently
  - Frequency of usage is often a function of accessibility and ease of use
  - Users also noted lack of transparency, inapplicability and inaccuracies as reasons models are not used more frequently

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# USERS & USES

## *Divergence*

### Which models/ applications do they use? How often?

***Military Operational***

- Reach back to the experts
  - IAC also calls on DTRA, national labs, and FRMAC
- Acknowledged that they have somewhat of a disconnect, because they aren't really expected to focus on CBRN, but all troops train in the environment
  - No good tool for campaign modeling: Estimate based on force flow

***Civilian***

- This sector expressed a desire to use models but noted two significant problems
  - General lack of knowledge about what's available
  - Inability to access many of the models that do exist

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# USERS & USES

## *Additional Considerations*

### Which models/ applications do they use? How often?

Some sample models currently in use include:

***Military Operational***

- HPAC
- CATS
- MAT
- [ships are not represented in the available models]

***Military Support***

- CREST and HPAC
- DOEHRS
- GEIS (DOD Global Emerging Infections System)
- Toxic load

***Civilian***

- NARAC
- CATS
- CAMEO
- FluSurge
- Biowatch
- BWIC (Biological Warning and Incident Characterization)
- EpiCast

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# USERS & USES

## *Consensus*

### What questions or issues do the models help answer?

- What you want to get out depends on who you are
- Questions answered include:
  - Casualty estimation
    - How many casualties? How many need to be treated and/or evacuated?
    - What are symptoms over time?
  - Policy and political decisions
    - Answer questions raised by the government or the within the community
    - Set criteria for exposure limits
    - Support hazard avoidance (occupational hazard)
  - Planning
  - Resource determination

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# USERS & USES

## *Consensus*

**How can these models be revised to provide better support?**

- Model MUST be EASY to use
- Model must address users questions
  - Scale of event
  - Time frame
  - Casualty categories (including worried well)
  - Robust and flexible to address changing scenarios, including certain non-WMD (i.e. explosives, contagious diseases)
  - Logistics Questions
  - Modeling to generate special equipment requirements (surgery, ventilators)
- Model must incorporate a non-military/adjustable definition of casualty

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# USERS & USES

## *Consensus (cont'd)*

**How can these models be revised to provide better support?**

- Models must be accredited
  - Models must be credible and include a method for assessing results
  - Assumptions of current models clearly stated, reasonable, and understandable
  - Use a common terminology and accepted definitions
  - Best possible data used
- Models should be publicly available and training should be provided
- Time must be incorporated

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## USERS & USES
### *Divergence*

**How can these models be revised to provide better support?**

***Civilian***

- Models should account for special needs populations
- Models must take into account local information
  - Population and how it changes
  - Demographics
  - Resources
  - Transportation availability

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## USERS & USES
### *Consensus*

**What questions or issues could these models help answer?**

- Planning
  - Logistics, medical, personnel
  - How severe are the casualties? Where are they clustered?
- Scenario development/Training
- Current event response
- Forensic, epidemiological and retrospective analysis
  - Know what it was and where it spread – where did it come from?

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# USERS & USES

## *Consensus (cont'd)*

**What questions or issues could these models help answer?**

- Analysis of alternatives
  - Know what the outcome needs to be but don't always know if the plan will work – use models as a tool to test/validate
  - Do we change the interventions if we have single instances of disease vs. large numbers of people sick with the disease? How?
- Civilian casualty estimation

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# USERS & USES

## *Divergence*

**What questions or issues could these models help answer?**

***Military Operational***

- Planning / Commander's Assessment
  - Long term (>7 years); deliberate operations; current events
- Additional utility is needed in
  - Consequence management
  - Natural & technological disasters

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# USERS & USES

## *Divergence (cont'd)*

**What questions or issues could these models help answer?**

### *Military Support*

- Justification and prioritization of research:
  - Research investment prioritization (which agents to focus on first)
  - Requirements setting for research and development (i.e. which new drugs to pursue)
  - Capturing the current research state and identifying gaps in research efforts (based on what's not in the models yet)
- Assisting in risk assessment:
  - Animal disease and food risk assessment
  - Food/waterborne disease risk assessment

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# USERS & USES

## *Divergence (cont'd)*

**What questions or issues could these models help answer?**

### *Civilian*

- Policy and legislative decision making
  - What is the impact of stockpiling or widely distributing KI near nuclear power plants?
  - Is post-exposure vaccination of value?
- Resource allocation and the impact of loss of resources
  - Could help argue for additional resources and/or personnel
  - How do emergency plans change when five hospitals close in NYC?
- Understand behavioral and compliance issues
  - How many worried well are expected?
  - What are the impacts of refusing vaccination or prophylaxis?
  - How is the government/agency/locality affected when people self-quarantine?

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IDA

# Discussion

# Consensus

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IDA

## USERS & USES

***Military Operational***

**In your organization, who currently uses human response models (either alone or within a suite of models)?**

- Planners – Personnel (G-1), Operations (G-3), Logistics (G-4), Surgeon
- Incident Analysis Cell (IAC) modelers
- Garrison and hospital planners use it
  - and are trying to work together

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## USERS & USES

### *Military Support*

**In your organization, who currently uses human response models (either alone or within a suite of models)?**

- USAMRIID: Some staff scientists/ researchers
- AFRRI: Some staff scientists/ researchers
- USAMRICD: Unclear if any human response models are used
- USAFSAM: Simulators (no longer part of USAFSAM)
- AFIOH: No current users
- AMEDD C&S: CASS modelers
- CHPPM: CSEPP program modelers
- ECBC: User and developer of human response models

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## USERS & USES

### *Civilian*

**In your organization, who currently uses human response models (either alone or within a suite of models)?**

- Used at several levels of Federal, state, and local government and by a number of organizations, including:
  - Department of Transportation and the transportation safety administrations
  - Federal Emergency Management Agency
  - NIOSH
  - National Labs
  - Locally:
    - Departments of Public Health and Mental Health
    - Emergency Management Departments
    - EMS
    - Fire Departments
    - Environmental Health and Protection

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## USERS & USES

*Military Operational*

### Are there others in your organization that could benefit from these models?

- Almost all: J1, J2, J3, J5, J7, J8
  - Possibly civil affairs or security
  - National Guard
- Constraint on use = small staffs
  - There is no full-time staff to run complicated models
  - Not going to be at the squad, platoon, etc. level.
  - Staffs needed and (possibly) available at higher echelons
- Needs to be reliable, accessible, and affordable to be used at every level: Tactical, operational & strategic

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## USERS & USES

*Military Support*

### Are there others in your organization that could benefit from these models?

- Researchers, scientists
  - In research
  - In operational reach-back
- Doctrine developers (USAFSAM)
- Trainers, exercise designers
- Environmental & operational health experts
- Planners & managers
  - Personnel
  - Operational
  - Logistics (medical and non-medical)

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# USERS & USES

## Civilian

### Are there others in your organization that could benefit from these models?

- Most organizations could benefit from Human Response Models:
  - Public Health
  - Emergency Operations and Emergency Management
  - Fire and Police Departments
  - EMS
  - Intel, Terrorism and Early Warning groups
  - HAZMAT personnel
  - FEMA
  - Transportation Departments
  - Hospitals

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# USERS & USES

## Military Operational

### Which models/ applications do they use? How often?

- Standard (Accepted) Models
  - HPAC, CATS, MAT, COFUMS (COEFMS?)
  - [… ships are not represented in the available models]
- Field Manuals, Rules of Thumb, and SWAG
  - Field Manuals (e.g., FM 101-3) plus baseline percentage to determine CBRN casualties, time of requirements
  - The "8-55" model (a "Schoolhouse" model).
  - Conventional estimate + 15%
  - Simple tabular products employing broad assumptions
  - Homegrown application for design of surgical support capability
  - Google earth overlays to show beds available
- Reach back to the experts
  - IAC also calls on DTRA, national labs, and FRMAC
- Acknowledged that they have somewhat of a disconnect, because they aren't really expected to focus on CBRN, but all troops train in the environment
  - No good tool for campaign modeling: Estimate based on force flow
- Pandemic Influenza
  - Flu Surge model, but it is disease specific and not linked to the campaign.
  - Some simplistic models available, perhaps not based on science

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# USERS & USES

## *Military Support*

### Which models/ applications do they use? How often?

- CASS users- CREST and HPAC
  - They use only the casualty estimation module of CREST
- DOORS model- public health risk assessment
- GEIS (DOD Global Emerging Infections System) information collection system
- CHPPM- CSEPP program support uses the ten Burge model for toxic load
- Unclear which models are used in remaining cases

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# USERS & USES

## *Civilian*

### Which models/ applications do they use? How often?

- **Rules of thumb, best guess, and estimation** are the most commonly used model/application in the civilian/government sector
  - These may be based on SMEs, CDC or WHO guidelines, military documents, historical experience, or any other number of sources
- This sector expressed a desire to use models but noted two significant problems
  - General lack of knowledge about what's available
  - Inability to access many of the models that do exist
- Models are to be use, but often infrequently
  - Frequency of usage is often a function of accessibility and ease of use
  - Users also noted lack of transparency, inapplicability and inaccuracies as reasons models are not used more frequently
- Models that are used with some regularity include:
  - Plume models and the associated casualty estimation tools are used by some during exercises and planning
  - FluSurge and BWIC have been used for planning and casualty estimation
  - Models not directly related to CBRN, including epidemiological models, resource tracking models, and logistics models

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# USERS & USES

## *Military Operational*

### What questions or issues do the models help answer?

- What you want to get out depends on who you are
  - Different levels of granularity
  - Possible use for Contingency Ops / Peace time
- Estimate casualties
  - How many personnel are casualties and need to be replaced; how many personnel need to be treated and/or evacuated; scope of civilian casualties in NEO situations
  - What are symptoms over time?
  - Link to personnel databases / unit databases
  - Effects of TICS/TIMS
- Determine med requirements: Resources, personnel - Link between Class VIII line items and Casualty Estimate
- COA → Be able to show Risk to Mission vs. Risk to Force (Counter WMD)
  - Is it worth going into an area for a mission?
- Specific Applications
  - Exercise planning
  - Planning for pandemics
  - Force-on-force modeling, wargaming

31

# USERS & USES

## *Military Support*

### What questions or issues do the models help answer?

- CASS users produce casualty estimates (primarily for conventional casualties)
- CHPPM uses human response models:
  - To set criteria for exposure limits
  - To support hazard avoidance (occupational hazard)
  - After an event, to evaluate who might have been exposed to a dose resulting in health impact
- ECBC modelers support CB Joint Program Managers
  - Evaluate operational impact of detection/protection systems

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# USERS & USES

## *Civilian*

**What questions or issues do the models help answer?**

- Addressing local concerns
  - HAZMAT spills, the implications of local nuclear power, disease spread, and possible threat scenarios
  - Used to answer questions raised by the government or the within the community
  - Also utilized during current event response
- Planning
- Training & Exercises
  - Can be used to develop scenarios, as well as during the scenarios themselves
- Retrospective analysis
- Budgeting & Resource estimation
  - Casualty estimates allow for estimation of available and necessary resources
  - Models allow for comparison of outcomes – help determine where resources and budgeting should be focused
  - Surge capacity requirements include personnel, emergency rooms, medical resources, countermeasures, ambulances, etc

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# USERS & USES

## *Military Operational*

**How can these models be revised to provide better support?**

- Model must address users questions
  - Scale of event
  - Time frame
  - Casualty categories (including worried well)
  - Robust and flexible to address changing scenarios
- Models must be accredited
  - Assumptions of current models clearly stated, reasonable, and understandable
  - Use a common terminology and accepted definitions
  - Standardize input factors and model considerations
  - Make them affordable, and easy to use
  - Distribute on accredited platforms (NMCI)
  - Train personnel in their use

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## USERS & USES
### *Military Support*

**How can these models be revised to provide better support?**

- The most difficult questions are from logisticians; users at AMEDD can't meet their needs.
- Modeling to generate special equipment requirements (surgery, ventilators) would be useful

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## USERS & USES
### *Civilian*

**How can these models be revised to provide better support?**

- Model MUST be EASY to use
- Models should account for the things that users are concerned with:
  - Worried Well
  - Special needs populations
  - A non-military definition of injury
  - Non-WMD scenarios, in particular explosives and contagious illnesses
- Models must take into account local information
  - Population and how it changes
  - Demographics
  - Resources
  - Transportation availability
- Models should be publicly available and training should be provided
- Models need to need improved:
  - Real-time inputs
  - Method for assessing results
  - Standardized outputs
  - Transparent assumptions and data sources
  - Better data

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# USERS & USES

## *Military Operational*

**What questions or issues could these models help answer?**

- Planning / Commander's Assessment
  - Logistics, medical, personnel
  - Long term (>7 years); deliberate operations; current events
  - Risk assessment at both the operational and personnel levels
- Exercise Support
  - Scenario development; planning and support
- Additional utility is needed in
  - Civilian casualty estimation
  - Casualty estimate within responding force
  - Retrospective / predictive analyses
  - Consequence management
  - Natural & technological disasters
  - Low-level contaminants

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# USERS & USES

## *Military Support*

**What questions or issues could these models help answer?**

- Justification and prioritization of research:
  - Research investment prioritization (which agents to focus on first)
  - Requirements setting for research and development (i.e. which new drugs to pursue)
  - Capturing the current research state and identifying gaps in research efforts (based on what's not in the models yet)
- Responding to operational situations (Non-specific symptoms, suspicious events, where medical response system may be the first indication)
- Assessing the impact of interventions:
  - Do we change the interventions if we have single instances of disease vs. large numbers of people sick with the disease? How?
- Assisting in risk assessment:
  - Animal disease and food risk assessment
  - Food/waterborne disease risk assessment

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# USERS & USES

## *Military Support*

### What questions or issues could these models help answer?

- Retrospective analysis
- Hazard analysis: deployment support, pre- or post- event
- Supporting policy-making
- Training and resource management
- Prospective studies
- Forensic/ epidemiological studies
- Symptom-based analysis/ agent identification
- Retrospective analysis
- Exploration of medical management strategies
- Supporting the planning process for responders
- Models can help support the entire planning process (analyze what-if scenarios)

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# USERS & USES

## *Civilian*

### What questions or issues could these models help answer?

- Policy and legislative decision making
  - What is the impact of stockpiling or widely distributing KI near nuclear power plants?
  - Is post-exposure vaccination of value?
- Plan development and analysis of alternatives
  - How severe are the casualties? Where are they clustered?
  - Know what the outcome needs to be but don't always know if the plan will work – use models as a tool to test/validate
- Resource allocation and the impact of loss of resources
  - Could help argue for additional resources and/or personnel
  - How do emergency plans change when five hospitals close in NYC?
- Understand behavioral and compliance issues
  - How many worried well are expected?
  - What are the impacts of refusing vaccination or prophylaxis?
  - How is the government/agency/locality affected when people self-quarantine?
- Forensic, epidemiological and retrospective investigations
  - Know what it was and where it spread – where did it come from?

40

## 3. SCOPE Attributes – INPUTS - Briefing

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Institute for Defense Analyses
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# Defining the Attributes of CBRN Human Response Models

# INPUTS

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 5, 2006

## Sub-Task Objective

*Identify the INPUTS which the user community feels must be considered, as well as those they anticipate having information about, for use in a CBRN Human Response Model.*

2

IDA

# INPUTS
## *Consensus*

### What parameters should the model address?

- **Agents?**
  - Everything!
  - Bio – CDC Category A
  - Bio – Naturally occurring and emerging infectious diseases
    - Pandemic Flu
    - Military is concerned with diseases for which military is vaccinated (for civilian epidemics)
    - Civilian sector is concerned with commonly occurring outbreaks (i.e. Measles, Pertussis, etc)
  - Chem – TICS/TIMS
  - Nuc/Rad – INDs, RDDs
  - Explosives

3

IDA

# INPUTS
## *Divergence*

### What parameters should the model address?

- **Agents?**

***Military Operational***

- Priority to warfare agents
  - Threat based?
- Hurricanes and other natural disasters

***Military Support***

- Want to be able to model next generation threats, emerging threats, not just the "classical" ones
- Combined exposures from different agents
- Water-borne/ food-borne illness agents, animal diseases with operational impact

4

IDA

# INPUTS
## *Divergence*

### What parameters should the model address?

- **Agents?**

***Military Operational***

- Priority to warfare agents
  - Threat based?
- Hurricanes and other natural disasters

***Military Support***

- Want to be able to model next generation threats, emerging threats, not just the "classical" ones
- Combined exposures from different agents
- Water-borne/ food-borne illness agents, animal diseases with operational impact

4

IDA

# INPUTS
## *Consensus*

### What parameters should the model address? (cont'd)

- **Exposure routes?**
  - All applicable routes
    - Inhalation
    - Ingestion
    - Cutaneous
    - Human vectors
    - Animal diseases

6

IDA

# INPUTS
## *Divergence*

### What parameters should the model address? (cont'd)

- **Exposure routes?**

***Military Operational* & *Military Support***

- Both expressed interest in combined exposures (i.e. trauma and radiological environment; multiple insults; simultaneous or consecutive radiological and biological insults)
- Military support requested the incorporation of partial-body exposures

7

IDA

# INPUTS
## *Consensus*

### What parameters should the model address? (cont'd)

- **Population at risk?**
  - Need to consider how PAR changes, for example:
    - Daytime vs. Nighttime populations
    - Population surge on special events
  - Need to consider scalability
    - Should utilize a basic scalable unit such as
      - Army brigade
      - Navy ship
      - Civilian hospital
    - May need to model anywhere "from 5 to 5 million"
  - Should have capability to subgroup the PAR
    - US forces vs. indigenous population
    - First responders, first receivers & "essential personnel"
    - Transportation workers (civilian)

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IDA

# INPUTS

## *Divergence*

### What parameters should the model address? (cont'd)

- **Population demographics?**
  - There is no consensus among the user community regarding:
    - Importance of demographics
      - Consider differences in demographics where we have information to support them; would like to see demographics modeled, but availability of data, and level of understanding, may be a problem
    - Which demographics are significant

9

IDA

# INPUTS

## *Divergence (cont'd)*

### What parameters should the model address? (cont'd)

- **Population demographics?**

***Military Operational***

- Population based on:
  - Range of military and civilian populations
  - Health status, age, response, gender, susceptibility (including those not vaccinated)…
  - But, recognize real world priorities

***Military Support***

- Even within this community, the organization function determines the requirements for (civilian, military) demographics
  - Users concerned with different population types/ broad civilian demographic
  - Don't consider population demographics for military or civilian

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IDA

# INPUTS

## *Divergence (cont'd)*

### What parameters should the model address? (cont'd)

- **Population demographics?**

***Civilian***

- Demographics are extremely important
  - Age – children, elderly, the "old-old"
  - Special needs – immuno-compromised, homeless, mobility and sensory disabled, pregnant, homebound, etc
  - Medical status
    - "The immune and the doomed"
  - Language, as it effects the ability to understand and comply with instructions
  - Socio-economic status and transportation access

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IDA

# INPUTS

## *Consensus*

### What parameters should the model address? (cont'd)

- **Medical protection?**
  - Medical protection should be modeled for all available items
    - Efficacy is important and may need to vary by demographic
    - Parameter may not be applicable to all users
    - Protection levels must be differentiated between military and civilian populations
  - Behavior and compliance must be modeled
    - These may not be known in advance – may want to include as inputs
    - "How are the eventual results changed if the population elects to remain at home rather than coming to work or if everyone comes to work?"

12

IDA

# INPUTS
## *Divergence*

### What parameters should the model address? (cont'd)

- **Medical protection?**

***Military Operational***

- Should consider all available
  - At least pre-exposure prophylaxis.
  - Differentiate protection levels between civilians and military
  - Adjust protection measures and countermeasures
- Tool perhaps should pull from unit or web databases
- Consider impact of IND regulations?

***Civilian***

- Items in the SNS and MMRS stockpiles should be modeled

13

IDA

# INPUTS
## *Consensus*

### What parameters should the model address? (cont'd)

- **Technical detection and/or surveillance?**
  - All users agreed that technical detection and syndromic surveillance should be incorporated where applicable
    - Particular focus was paid to effect and speed of notification
    - In the civilian sector, detection is not under local control and so for local governments, it only comes after a time delay – "It would be nice to prove that the time delay makes a difference in our ability to respond"
    - Interest expressed in veterinary surveillance

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IDA

# INPUTS

## *Additional Considerations*

### What parameters should the model address? (cont'd)

- **Technical detection and/or surveillance?**

***Military Support***

- Want to model all available and theoretical (user-specified parameters)

***Civilian***

- Technical detection
  - Particularly in transportation modes and at points of entry
- Medical surveillance
  - Concerns expressed regarding information overload and privacy

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IDA

# INPUTS

## *Divergence*

### What parameters should the model address? (cont'd)

- **Treatment?**
  - Users varied in their desire for representation of treatment:
    - Which treatments
    - Levels of treatment
    - Need for efficacy data
    - Clinical outcomes

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IDA

# INPUTS

## *Divergence (cont'd)*

### What parameters should the model address? (cont'd)

- **Treatment?**

***Military Operational***

- Should consider up to at least Level 4
  - Match with decontamination and evacuation requirements
- Want to be able to answer: How many recover? How long to recover?

***Civilian***

- Model the things available in the SNS and MMRS – both medication and medical equipment
- Include treatments known and unknown at the local level
- Need to know the resultant side-effects, secondary illnesses

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IDA

# INPUTS

## *Additional Considerations*

### What parameters should the model address? (cont'd)

- **Other?**
  - Physical protection
    - Collective (Shipboard isolation quarantine, pressurized rooms, etc.)
    - Individual (e.g. surgical masks)
    - In the civilian community, physical protection is available mostly to the first responders and first receiver community
  - Local environmental factors (background or endemic levels)
  - Pre-deployment issues vs. Attack vs.Post-deployment
  - Evacuation – want to be able to model the impacts of shelter-in-place vs. evacuation

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# INPUTS

## Additional Considerations

- **What inputs would you like to specify?**
- **For each specific use, what information are you likely to know to input into these models?**

### *Military Support*

- Assume omniscient information for exploring various scenarios, planning, training
- Demographic information is not necessarily available
- Information that is not known will be assumed for the purposes of modeling
  - If insufficient amount of information is known, perhaps modeling should not be done

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# INPUTS

## Additional Considerations

- **What inputs would you like to specify?**
- **For each specific use, what information are you likely to know to input into these models?**

### *Civilian*

- Need to be able to vary the inputs and the assumptions
  - Especially for planning, policy, and resource estimation
  - Cannot assess alternatives without the ability to change the inputs
- Agents, exposure routes, and treatment may all be based on best, information-available guess
  - Even when detection is available, local governments are not currently notified until after agent confirmation

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# INPUTS

## Scenario-Based Planning/Training

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| Agents | Yes (Assumed) | Yes (Assumed) |
| Exp. Routes | Probably | Yes (Assumed) |
| Pop. at Risk | Yes (Assumed) | Yes (Assumed) |
| Demographics | Yes (Assumed) | Yes (Assumed) |
| Med. Protection | Yes (Assumed) | Yes (Assumed) |
| Detection & Surv. | Yes (Assumed) | Want to vary |
| Treatment | Probably | Want to vary |
| Other | Perhaps | |

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# INPUTS

## Current Event Response

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| Agents | Not at first, may assume | Not at first, may assume, possibly w/I hours |
| Exp. Routes | Assumed | Possibly once agent is known |
| Pop. at Risk | Estimate (Mil/Civ) | Immediate at risk assessment, not all |
| Demographics | N/A, or Yes | Yes (working assumption) |
| Med. Protection | Yes, or may Assume | Not applicable |
| Detection & Surv. | Yes | Yes |
| Treatment | Yes, for Mil | Agent dependent, may make calculated guess |
| Other | Perhaps | Symptoms! |

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IDA

# INPUTS

## *Retrospective Analysis*

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| Agents | Yes | Yes |
| Exp. Routes | Yes | Yes |
| Pop. at Risk | Estimate (Mil/Civ) | Maybe |
| Demographics | N/A, or Yes | Yes |
| Med. Protection | Yes, or may Assume | Not applicable |
| Detection & Surv. | Yes | Yes |
| Treatment | Yes, for Mil | Yes |
| Other | Perhaps | Maybe |

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IDA

# Discussion

# Consensus

24

# INPUTS

## *Military Operational*

### What parameters should the model address?

- **Agents?**
  - Priority to warfare agents
    - Threat based?
  - CDC Category A (esp. weaponized)
  - TICS/TIMS/INDs
  - Naturally occurring and emerging diseases
    - Pandemic Flu
    - diseases for which military is vaccinated (for civilian epidemics)
  - Explosives
  - Hurricanes and other natural disasters
  - Prioritize which is most dangerous and/or most likely

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# INPUTS

## *Military Operational*

### What parameters should the model address? (cont'd)

- **Exposure routes?**
  - All: Inhalation, cutaneous, food/waterborne, transdermal, animal diseases, …
  - Should also consider combined injuries
- **Population at risk?**
  - PAR depends on event and changes over time
  - US Forces deployed and indigenous population
    - Civilian population is sometimes addressed by the excess military capacity, or may be the principal planning population
  - Should consider
    - For military (Army) purposes, perhaps look at BCT-size force (4000) as basic size
    - Or look at increments of 1,000 for planning purposes
    - Also consider ships, units, installations
  - Consider who has protection and who has not

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IDA

# INPUTS

## *Military Operational*

### What parameters should the model address? (cont'd)

- **Population demographics?**
  - Not always a significant consideration
  - For the same populations as above, stratify
    - Range of military and civilian populations
    - Health status, age, response, gender, susceptibility levels (including those not vaccinated)…
    - But, recognize real world priorities
  - Possible sources of demographics data: census, school absenteeism?

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IDA

# INPUTS

## *Military Operational*

### What parameters should the model address? (cont'd)

- **Medical protection?**
  - Should consider all available
    - At least pre-exposure prophylaxis.
    - Differentiate protection levels between civilians and military
    - Adjust protection measures and countermeasures
  - Include physical protection
    - Collective (Shipboard isolation quarantine, pressurized rooms, etc.)
    - Individual (Military and expedient, e.g. surgical masks)
  - Tool perhaps should pull from unit or web databases
  - Consider impact of IND regulations?
- **Technical detection and/or surveillance (external)?**
  - Should consider syndromic detection and technical detection, when available and appropriate
    - Would like to see veterinary surveillance
  - Tool perhaps should pull from unit or web databases

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IDA

# INPUTS

## *Military Operational*

### What parameters should the model address? (cont'd)

- **Treatment (external)?**
  - Should consider up to at least Level 4
    - Match with decontamination and evacuation requirements
  - Want to be able to answer: How many recover? How long to recover?
  - Tool perhaps should pull from unit or web databases
- **Additional Parameters to consider:**
  - Inputs should be tailorable
  - Scenarios need to be modifiable
  - Background levels of illness and contamination
  - Pre-deployment issues vs. Attack vs.Post-deployment
  - Input worried well, as a percentage

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IDA

# INPUTS

## *Military Support*

### What parameters should the model address?

- **Agents:**
  - Want to be able to model next generation threats, emerging threats, not just the "classical" ones
  - Combined exposures
  - Agents on the CDC and Homeland Security list, at the least; ideally, any threat that produces casualties
  - Water-borne/ food-borne illness agents, animal diseases with operational impact
  - TICs, TIMs, various rad isotopes
- **Exposure Routes:**
  - Partial-body exposures
  - Combined exposures (i.e. trauma and radiological environment; multiple insults; simultaneous or consecutive radiological and biological insults)
  - All applicable forms of exposure should be considered

30

IDA

# INPUTS

## *Military Support*

### What parameters should the model address? (cont'd)

- **Population at Risk:**
  - Need to model 5 people to 5 M people
  - Including various demographics (military, civilian)
- **Population Demographics:**
  - Consider differences in demographics where we have information to support them; would like to see demographics modeled, but availability of data, and level of understanding, may be a problem
  - Emergency medical personnel should be included as a separate demographic (medical protection should be modeled for them)
  - Users concerned with different population types/ broad civilian demographic
  - Consider the most susceptible subgroup within civilian demographics
  - Don't consider population demographics for military or civilian
  - Breakdown of military demographics not required for some users

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IDA

# INPUTS

## *Military Support*

### What parameters should the model address? (cont'd)

- **Medical Protection:**
  - Want to model medical interventions, especially medical countermeasures
  - Characteristics of medical countermeasures (such as efficacy)
  - Medical countermeasures in place (such as vaccination status)
- **Technical Detection & Surveillance:**
  - Want to model all available and theoretical (user-specified parameters)
  - Type and level of detection
  - Effects and speed of detection/ diagnoses
- **Treatment:**
  - Efficacy of treatment as a function of time
  - Do not need to consider effectiveness of treatment (only general level of medical care required should be output)
- **Other:**
  - Quality of radiation (standard-physics)
  - Local environmental factors (background or endemic levels)
  - Population behavior (compliance levels, worried well)
  - Logistical consideration must be a visible input into the model or an observable input

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IDA

# INPUTS

## Civilian

### What parameters should the model address?

- **Agents?**
  - The Agents included in the DHS Planning Scenarios
  - Explosives
    - "Historically, it's been assumed that civilian planners/ responders knew about explosives, and it's not true. It's not something we ever deal with."
  - CDC Category A – Anthrax, Smallpox, VHF, Tularemia, BoNT
  - Chemicals
    - Nerve agents – disagreement among the cities
    - TICS/TIMS/INDs -- "Anything that's transported in or through the city"
  - Rad & Nuc – particularly due to location (i.e. near a nuclear power plant or a Naval nuclear aircraft carrier base)
  - Naturally occurring and emerging diseases – Pandemic Flu, Measles, Pertussis

33

IDA

# INPUTS

## Civilian

### What parameters should the model address? (cont'd)

- **Exposure routes?**
  - All: Inhalation, dermal, food/waterborne, human vectors …
- **Population at risk?**
  - Need to consider how PAR changes:
    - Daytime vs. Nighttime populations
    - Seasonal fluxuations
    - Population surge on special events
      - i.e. Special events in Boston can increase the city's population tenfold
  - Want to apply filters to account for "essential" personnel
    - First responder & first receiver populations
    - Transportation workers
  - Want to incorporate information from Bionet and Biowatch

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IDA

# INPUTS

## Civilian

### What parameters should the model address? (cont'd)

- **Population demographics?**
  - Demographics are extremely important
    - Age – children, elderly, the "old-old"
    - Special needs – immuno-compromised, homeless, mobility and sensory disabled, pregnant, homebound, etc
    - Medical status
      - "The immune and the doomed"
    - Language, as it effects the ability to understand and comply with instructions
    - Socio-economic status and transportation access
  - Behavior and compliance must be modeled
    - These may not be known in advance – may want to include as inputs
    - "How are the eventual results changed if the population elects to remain at home rather than coming to work or if everyone comes to work?"

35

IDA

# INPUTS

## Civilian

### What parameters should the model address? (cont'd)

- **Medical protection?**
  - Medical protection is not a real consideration for most government/civilian organizations
    - Would model the items available in the SNS and MMRS stockpiles
    - Mostly, medical protection is not generally available
    - One exception – in many cities, MK I kits are forward deployed to the first responders and first receivers
  - Physical protection, but on a limited basis
    - Physical protection is available mostly to the first responders and first receiver community
    - Would model individual items – masks, surgical gloves, etc.
- **Technical detection and/or surveillance (external)?**
  - Technical detection
    - Particularly in transportation modes and at points of entry
    - Detection is not under local control and so for local governments, it only comes after a time delay – "It would be nice to prove that the time delay makes a difference in our ability to respond"
  - Medical surveillance
    - There are multiple tools that model syndromic info – HAN, EMAT, etc
    - Concerns expressed regarding information overload and privacy

36

IDA

# INPUTS

*Civilian*

## What parameters should the model address? (cont'd)

- **Treatment (external)?**
  - Model the things available in the SNS and MMRS
    - Available medications
    - Medical equipment
  - Include treatments known and unknown at the local level
  - Want to be able to use model to determine the effects of certain treatments (i.e. primary vs. alternates)
  - Need to know the resultant side-effects, secondary illnesses
- **Additional Parameters to consider:**
  - Evacuation – want to be able to model the impacts of shelter-in-place vs. evacuation

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IDA

# SCOPE -- Inputs

*Scenario-Based Planning/Training* - Military Support

## What inputs would you like to specify?

- **For each specific use, what information are you likely to know to input into these models?**

- Assume omniscient information for exploring various scenarios, planning, training
- Demographic information is not necessarily available
- Information that is not known will be assumed for the purposes of modeling
  - If insufficient amount of information is known, perhaps modeling should not be done

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# INPUTS

## Scenario-Based Planning/Training

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| **Agents** | Yes (Assumed) | Yes (Assumed) |
| **Exp. Routes** | Probably | Yes (Assumed) |
| **Pop. at Risk** | Yes (Assumed) | Yes (Assumed) |
| **Demographics** | Yes (Assumed) | Yes (Assumed) |
| **Med. Protection** | Yes (Assumed) | Yes (Assumed) |
| **Detection & Surv.** | Yes (Assumed) | Want to vary |
| **Treatment** | Probably | Want to vary |
| **Other** | Perhaps | |

40

# INPUTS

## Current Event Response

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| **Agents** | Not at first, may assume | Not at first, may assume, possibly w/I hours |
| **Exp. Routes** | Assumed | Possibly once agent is known |
| **Pop. at Risk** | Estimate (Mil/Civ) | Immediate at risk assessment, not all |
| **Demographics** | N/A, or Yes | Yes (working assumption) |
| **Med. Protection** | Yes, or may Assume | Not applicable |
| **Detection & Surv.** | Yes | Yes |
| **Treatment** | Yes, for Mil | Agent dependent, may make calculated guess |
| **Other** | Perhaps | Symptoms! |

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# INPUTS

## *Retrospective Analysis*

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| **Agents** | Yes | Yes |
| **Exp. Routes** | Yes | Yes |
| **Pop. at Risk** | Estimate (Mil/Civ) | Maybe |
| **Demographics** | N/A, or Yes | Yes |
| **Med. Protection** | Yes, or may Assume | Not applicable |
| **Detection & Surv.** | Yes | Yes |
| **Treatment** | Yes, for Mil | Yes |
| **Other** | Perhaps | Maybe |

42

# INPUTS

## *Research*

- What inputs would you like to specify?
- For each specific use, what information are you likely to know to input into these models?

| | Mil. Ops | Civilian |
|---|---|---|
| **Agents** | N/A | N/A |
| **Exp. Routes** | N/A | N/A |
| **Pop. at Risk** | N/A | N/A |
| **Demographics** | N/A | N/A |
| **Med. Protection** | N/A | N/A |
| **Detection & Surv.** | N/A | N/A |
| **Treatment** | N/A | N/A |
| **Other** | N/A | N/A |

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## 4. SCOPE Attributes – OUTPUTS/TIME - Briefing

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Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882

# Defining the Attributes of CBRN Human Response Models

# OUTPUTS/TIME

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 5, 2006

## Sub-Task Objective

*Identify the* OUTPUTS *which the user community feels a CBRN Human Response Model must provide.*

*Identify the* TIMES, *both as input and output, which the user community feels should be represented within a CBRN Human Response Model.*

2

# OUTPUTS

## Consensus

### What information should the models output?

- Number, location and time phase of:
  - Exposed
  - Well
  - Casualties (ill/ injured)
  - Fatalities
  - Worried well
  - Psychological casualties
- Casualties, divided into categories:
  - By type of injury or illness
  - By health status
    - Symptom/ systemic effects details
    - Clinical outcome
  - By performance level
  - By intervention required (walks out on own, needs assistance)

3

# OUTPUTS

## Consensus

### What information should the models output? (cont'd)

- Changes in casualty status over time
  - Clinical progression of illness
    - Change in injury/ illness over time, including symptoms
  - Performance over time
- Necessity for treatment requirements varied by type of user
  - How many people need treatment and when
  - What type of treatment is needed
    - Grouping suggestions:
      - by Patient Care Code
      - by Treatment Protocol
  - How required treatment changes over time
- Outputs should provide enough information to help make decisions – should be reliable and actionable

4

IDA

# OUTPUTS

## *Divergence*

### What information should the models output? (cont'd)

***Military Operational***

- Casualties
  - Differentiate Civilians & Military
- Unit operational capability
  - Tasks, time phase and severity of unit degradation
- Capability to conduct sensitivity analyses
  - Assess impact of delaying care on medical workload and outcomes
  - Assess impact of evacuation policy on medical requirements
- Medical resource requirements
  - Weight / Cube | Type / Supplies | Evac / Staying
  - Critical Components (ventilators, ICU beds)

***Military Support***

- Number of people potentially exposed or located in exposure area
  - For determining prophylaxis requirements, for example

5

IDA

OUTPUTS

*Divergence*

What information should the models output? (cont'd)

***Civilian***

- Casualties, divided into categories:
  - By color-coded triage level
  - Identify the most at-risk populations, those with an inordinate number of casualties
- Behavioral response
  - Percentage of the population that complies with shelter-in-place, quarantine, evacuation rules
  - Percentage that does not comply, due to fear, anger, etc.
- Capability to conduct sensitivity analyses
  - Compare model outputs with actual data (during event)
  - Assess impact of delaying resource delivery on medical outcomes
- Medical resource requirements
  - Weight / Cube | Type / Supplies

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# OUTPUTS

## *Consensus*

**Do you want to be able to define the output ranges?**
**Do you want to be able to change them?**

- Definition of casualty is highly user dependent
- Users want capability of defining endpoint/ casualty output ranges, as well as predefined defaults, and filters for the outputs
  - Define based on:
    - Triage levels
    - Types of injuries or symptoms
    - Types of care required
  - Filter:
    - Medical staff

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# OUTPUTS

## *Divergence*

**Do you want to be able to define the output ranges?**
**Do you want to be able to change them? (cont'd)**

***Civilian***

- Filter casualties based on:
  - First responder/first receiver communities
  - Special needs populations, including those with language or transportation needs
- Scarcity of resources and mass casualty events might require alternate definitions of casualty
  - "What's the tipping point"
- Output range should be expressed in terms of length of care and type of care required

8

# OUTPUTS

## Consensus

### Would you like to see risk/ hazard confidence assessments? How would you like to see confidence expressed?

- All stakeholders stressed the importance of having confidence in the data and being able to see that confidence expressed
  - Even if not expressed to decision-makers
- Users did not agree on how confidence should be expressed
- Some suggested options for expressing confidence include:
  - Color-coding or high/medium/low
  - Percentages
  - Statistical representations
  - Numerical or ratio bounds
    - Provides (implies?) a higher level of accuracy and precision
  - Applicability statements, including caveats of the circumstances under which the confidence changes

9

# OUTPUTS

## Consensus

### Would you like to see risk/ hazard confidence assessments? How would you like to see confidence expressed? (cont'd)

- Users need to understand the significant factors contributing to confidence assessment:
  - Confidence in underlying data
  - Confidence in its applicability to scenario
  - Confidence in the algorithms
  - Confidence in inputs (assumptions)
- Users want a sensitivity analysis capability
  - Want to know which assumptions need to be refined to improve confidence
  - Want indication of areas of largest uncertainty that could be resolved with more information
- Users agree that outputs should convey accurate fidelity

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# OUTPUTS

## *Additional Considerations*

**Would you like to see risk/ hazard confidence assessments? How would you like to see confidence expressed? (cont'd)**

- *OBSERVATION: Wargaming/ modeling are based on assumptions, so there is an understanding that there is the potential for some error that is introduced*
- Users want the best possible model that science can provide at this time
  - "Hopefully we will never find out if we were wrong"

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# TIME

## *Consensus*

**Should time be a factor in the model?**
**Should time be considered as an input?**
- **What times are important to you as the user?**

- All interviewees expressed that time is a key factor in a human response model
- Users should be allowed to input or modify the following times:
  - Time of exposure
  - Time of patient presentation (from surveillance)
  - Time of detection
    - Civilian sector concerned with detection reporting delays
  - Time of applying medical protection and/or treatment
    - Concerns expressed regarding delays in receiving additional resources

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IDA

# TIME

## *Consensus*

**Should time be a factor in the model?**
**Should time be considered as an input?**

- **What times are important to you as the user? (cont'd)**

- Patient presentation times vary by agent
  - Chemical and nuclear- need to be represented in minutes
  - Biological- can be represented in larger time blocks

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IDA

# TIME

## *Divergence*

**Should time be a factor in the model?**
**Should time be considered as an input?**

- **What times are important to you as the user? (cont'd)**

### *Military Operational*

- Want ability to scope the range of outputs by inputting information regarding response at various time points

### *Civilian*

- Time of year was noted as a factors that can alter triage and treatment protocols, as well as population at risk
  - Staffing shortages
  - Weather impact

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IDA

# TIME

## Consensus

### Should time be considered as an output?

- **What time intervals should outputs be divided into? (Minutes? Hours? Days? Months?)**

- The start of the timeline …
  - Time=0, with high resolution initially (hours), then low-resolution (days)
- Outputs should be reported with decreasing granularity over time: minutes, hours, lifetime
- The length of the timeline will depend on:
  - Agent
  - Dose (chronic vs. acute)
  - Impact of intervention over time

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IDA

# TIME

## Consensus

### Should time be considered as an output? (cont'd)

- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

- The model should consider acute, latent and chronic effects
- Acute and latent effects will likely be of greatest concern to all users
  - Chronic or long-term disposition of personnel not important for some users
  - For others, long-term effects should also be considered
    - Combat commanders need to know long-term repercussions for decision-making/accountability
    - Public health and the government in general concerned with long-term care issues (responsibility, recovery, viability)

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IDA

# TIME

## *Divergence*

### Should time be considered as an output? (cont'd)

- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

### *Military Operational & Support*

- The issue of time and time intervals will likely be mission dependent
- The end of the timeline will vary by user type– until response is no longer necessary
  - Operators may only be concerned until casualty is evacuated
  - Contingency planners may want to be able to go out further (30-60 days)
  - Deliberate planning may want to go out even further
  - Strategic planners will want to be able to estimate until an individual is either returned to duty or discharged
- In summary:
  - Tactical: Until dead, evacuated or RTD
  - Operational: Until anticipated end of operation (6 months?)
  - Strategic: Until recovery or discharge

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IDA

# TIME

## *Divergence*

### Should time be considered as an output? (cont'd)

- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

### *Civilian*

- Public health and the government in general need to be concerned with long term care issues
  - "The length of illness and the requirements for long term care impact the viability and recovery of the city, as well as the long term viability of the health care system"
  - "Long term views allow you to assess the real risks of treatment – not just the short term effects but also the long term impacts"

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IDA

# Discussion

# Consensus

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IDA

## OUTPUTS

***Military Operational***

**What information should the models output?**

- Number, location and time phase of
  - Exposed
  - Health status
    - Symptom / systemic effects detail
    - Acuity Levels
    - Psychological casualties, worried well
    - Differentiate Civ & Mil
  - Outcome (numbers and rates)
    - Patients (by PC?)
      - Length of stay / Recovery times
    - Casualties
    - Fatalities
  - Unit operational capability
    - Tasks, time phase and severity of unit degradation

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# OUTPUTS

## *Military Operational*

### What information should the models output? (cont'd)

- Med Mgmt Model
  - Med countermeasures
  - Med Resource Reqmts
    - Weight / Cube | Type / Supplies | Evac / Staying
    - Critical Components
    - Impact of delaying care on Med Requirements
- Epi Estimates
- Sensitivity Analysis
  - Need to understand how planning factors and scenarios interact with each other
- Confidence
- Identify Model and Assumptions

Simplistically: If X exposure, you'll get Y effect at Z time

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# OUTPUTS

## *Military Support*

### What information should the models output?

- Number of people potentially exposed or located in the exposure area (for prophylaxis, for example)
- Number of people affected (injured, ill), divided into classes or categories
- Casualties (predefined or user-defined):
  - Numbers
  - Types
  - Locations
- Course of injury or illness based on exposure:
  - Timing of injury or illness
  - Clinical data (biomarkers)
  - Exhibited systemic symptoms
  - Outcome
- Changes in casualty status over time
- Treatment levels required for casualties
  - How many people would need treatment
  - What type of treatment would be needed
- It is important that the models produce results which are actionable- bottom line for some users

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# OUTPUTS

## Civilian

### What information should the models output?

- Number of people who are:
  - Well, Casualties, Fatalities, Worried well
- Casualties:
  - By Type
  - By Injury
  - By color-coded triage level
  - By required care
  - By intervention required – Walks out on own, Needs assistance, Dies anyway
  - Identify the most at-risk populations, those with an inordinate number of casualties
- Clinical progression and outcome – how the injury changes over time, including symptoms
  - This includes a performance component – who comes to work, who's too sick to work
- Behavioral response
  - Percentage of the population that complies with shelter-in-place, quarantine, evacuation rules
  - Percentage that does not due to fear, anger, or other reason
- Required Medical Care and the associated resource requirements
- Outputs should help make decisions – should be reliable and actionable

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# OUTPUTS

## Military Operational

### Do you want to be able to define the output ranges? Do you want to be able to change them?

- Some outputs should be built in, but should also allow for user inputs to define casualty at a given output level
  - Level / Intensity within
    - Severity of Symptoms
    - Severity of Injury / Illness
    - Performance
- Commander worried about unit capability

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# OUTPUTS

## *Military Support*

**Do you want to be able to define the output ranges? Do you want to be able to change them?**

- Users want capability of defining endpoint/ casualty output ranges, as well as predefined defaults
- Need ability to change threshold levels for casualties
  - For example, combat commanders may set the casualty threshold at a higher level
- Binning of outputs (such as casualty or illness categories) should be based on treatment requirements; the number of categories should depend on the disease and the potential user

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# OUTPUTS

## *Civilian*

**Do you want to be able to define the output ranges? Do you want to be able to change them?**

- Users want predefined defaults, but want to be able to define ranges and filters for the outputs
  - Defined based on:
    - Triage levels
    - Injuries or symptoms
    - Types of care required
  - Filter with:
    - First responder/first receiver communities
    - Special needs populations, including those with language or transportation needs
- Scarcity of resources and mass casualty events might require alternate definitions of casualty
- Output range should be expressed in terms of length of care and type of care required

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# OUTPUTS

## *Military Operational*

### Would you like to see risk/hazard confidence assessments? How would you like to see confidence expressed?

- Start off with the assumption that model is Verified, Validated, and Accredited, and that the model is the best that science can provide at this time.
- Yes, would like to see confidence assessments
  - Accurate fidelity
  - Significant factors contributing to confidence assessment
  - Assumptions which need to be refined to improve confidence
    - Data inputs are assumptions
  - Even if not expressed to decision-makers

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# OUTPUTS

## *Military Operational*

### Would you like to see risk/hazard confidence assessments? How would you like to see confidence expressed? (cont'd)

- Expression of confidence levels
  - Color coding
  - Numerical or ratio bounds
    - Provides (implies?) a higher level of accuracy and precision
  - Dependent on the quality of the model
    - Part of it is algorithms (data, model)
    - Part of it is the users' confidence in inputs
- Should have a sensitivity analysis capability
- *OBSERVATION: Wargaming is based on assumptions, so there is an understanding that there is the potential for some error that is introduced*

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# OUTPUTS

## *Military Support*

### Would you like to see risk/hazard confidence assessments? How would you like to see confidence expressed?

- All interviewees would like model to include some means of representing confidence (Is there enough confidence in using models to make a decision based on outputs?)
  - Confidence in underlying data? Methodology? Outputs?
  - Some interviewees recognize that the confidence intervals may be so large that they overlap
- Preferences for expressing confidence varied widely among interviewees
- Suggested ways to represent confidence/ uncertainty levels:
  - Qualitative estimates: Color-coding, high/medium/low
  - Quantitative confidence estimates only (stay away from colors)
  - Confidence can be presented as high/medium/low as long as clearly defined (50%, 90%, etc.). Providing the user with too much numerical analysis can be counterproductive.
  - Express confidence levels as low/medium/high and provide explanations of data inadequacies
  - Indicate areas of largest uncertainty that could be resolved with more information

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# OUTPUTS

## *Civilian*

### Would you like to see risk/hazard confidence assessments? How would you like to see confidence expressed?

- All stakeholders stressed the importance of having confidence in the data and being able to see that confidence expressed
  - Would need to understand the basis for the confidence level – confidence in the data, confidence in its applicability, confidence in the estimation?
  - "Need to know the 'validity'. - Keep the agents out of the assessments of confidence"
  - Need for representing the confidence expressly is user-dependent – high level users want simple answers, whereas medical planners might require confidence assessments
- Confidence levels could be drawn from a number of sources including research and experimentation, data confidence levels, or SME estimation
- No real preference expressed for a method
  - Color-coding
  - Percentages
  - Statistical representations
  - Applicability statements, including caveats of the circumstances under which the confidence changes

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# TIME

## *Military Operational*

**Should time be a factor in the model?**

- YES, DEFINITELY

**Should time be considered as an input?**

- **What times are important to you as the user?**
- The issue of time and time intervals will likely be mission dependent (e.g., there is WMD in the vicinity or neutralization of WMD site)
- The start of the timeline … ???
  - Time=0, with high resolution initially (hours), then low-resolution (days)
- The length of the timeline will depend on
  - Agent
  - Dose (Chronic vs. acute)
  - Impact of intervention over time
- The end of the timeline – until response is no longer necessary
  - Operators may only be concerned until casualty is evacuated
  - Contingency planners may want to be able to go out further (30-60 days)
  - Deliberate planning may want to go out even further
  - Strategic planners will want to be able to estimate until an individual is either returned to duty or discharged
  - Want ability to scope the range of outputs by inputting information regarding response at various time points.

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# TIME

## *Military Support*

**Should time be a factor in the model?**

**Should time be considered as an input?**

- **What times are important to you as the user?**

- All interviewees expressed that time is a key factor in a human response model
- Users should be allowed to input time when applicable to the study:
  - Time of exposure
  - Time of symptom onset (from surveillance)
  - Time of detection
  - Time of applying medical protection and/or treatment

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IDA

# TIME

## *Civilian*

**Should time be a factor in the model?**

- YES!

**Should time be considered as an input?**

- **What times are important to you as the user?**

- Users should be able to input or modify the following times:
  - Time of patient presentation
  - Time windows for effective prophylaxis and treatment
  - Time windows associated with detection reporting delays
  - Time delays in receiving additional resources
- Reporting times vary by agent
  - i.e. Chemical and nuclear need to be represented in minutes, whereas bio can be represented in larger time blocks
- Time of day and year was noted as a factor that can alter triage and treatment protocols, as well as population at risk

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IDA

# TIME

## *Military Operational*

**Should time be considered as an output?**

- **What time intervals should outputs be divided into? (Minutes? Hours? Days? Months?)**
- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

- User defined, within specified parameters
- Start at first available intervention
  - Immediate impact (t=0)
  - Early / Rapid Response (t=30-60 minutes)
  - Strategic Response (t=72-96 hours)
- Report in minutes/hours for early effects, days/weeks for later effects
  - Acute and latent casualties
  - Injury severity over time (course of injury)
    - OR Symptom severity over time OR Performance over time
  - Cumulative and snap-shots of information over time is desired.
- End no earlier than 72 hours
  - Tactical: Until dead, evac'd or RTD
  - Operational: Until anticipated end of operation (6 months?)
  - Strategic: Until recovery (lifetime?)

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IDA

# TIME

## *Military Support*

### Should time be considered as an output?

- **What time intervals should outputs be divided into? (Minutes? Hours? Days? Months?)**
- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

- The model should consider acute, latent and chronic effects, with focus on acute and latent effects
  - Analyses of long-term, chronic effects can employ other tools, since there will be more time to do the analysis
  - Chronic or long-term disposition of personnel not important for some users
- Operationally relevant time frame is the short term on the time scale of an operation:
  - Time scale to be considered depends on evacuation policy
  - Outputs should be reported with decreasing granularity over time: minutes, hours, lifetime
  - Time scale on the order of 6 months should be considered
- For certain uses, long-term effects should also be considered
  - Combat commanders need to know long-term repercussions for decision-making/accountability

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IDA

# TIME

## *Civilian*

### Should time be considered as an output?

- **What time intervals should outputs be divided into? (Minutes? Hours? Days? Months?)**
- **What time periods are you concerned with for observing casualties? (Acute? Latent? Chronic/protracted?)**

- Time periods for modeling output are a function of the agent
  - "Need longer time periods for bio (days to weeks), hours or days for chem"
  - "If you don't think about the time people are casualties, you can't begin to get into recovery"
- The model should allow for consideration of consider acute, latent and chronic effects
  - Acute and latent will be the effects likely addressed by emergency managers
  - Public health and the government in general need to be concerned with long term care issues
    - "The length of illness and the requirements for long term care impact the viability and recovery of the city, as well as the long term viability of the health care system"
    - "Long term views allow you to assess the real risks of treatment – not just the short term effects but also the long term impacts"

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## 5. METHODOLOGY Attributes - Briefing

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Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882

# Defining the Attributes of CBRN Human Response Models

# METHODOLOGY

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Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 5, 2006

## Sub-Task Objective

*Identify any* METHODOLOGIES *which the user community feels must be included in a CBRN Human Response Model or which should be excluded.*

2

# METHODOLOGY
## *Consensus*

What methodology should be used in the human response model? Do you have a preference or recommendation?

- Probit? Performance-based? Toxic load? Other?

- The methodology must include what is appropriate for the agent, population and response being modeled
  - Estimates of casualties and fatalities are necessary but not sufficient
  - Time dimension of human response must be considered
  - Duration of exposure should be considered as appropriate
  - Capability should be represented
  - Nature and severity of signs and symptoms should be captured

3

# METHODOLOGY
## *Consensus*

What methodology should be used in the human response model? Do you have a preference or recommendation?

- Probit? Performance-based? Toxic load? Other?

- One model does not fit all agents, possibly requiring multiple methodologies
  - Availability of data should drive selection of model for any given scenario
    - It may be difficult or impossible to dig out original data from unpublished research
  - Preference should be given to methodologies that are accredited, validated and defensible

4

# METHODOLOGY
## *Divergence*

What methodology should be used in the human response model? Do you have a preference or recommendation?

- Probit? Performance-based? Toxic load? Other?

### *Military Operational*

- Users generally didn't know enough about existing methodologies, and didn't really seem to care
  - "Don't tell me what I don't need to know"

### *Military Support*

- While researchers do not seem to want aspects of the response model methodology to be inputs for all users, they would like to be able to subject them to sensitivity analyses
  - Would like to be able to change the underlying distributions
- If there are competing methodologies, they should be included in the model; the user should be able to do multiple calculations, if necessary

5

# METHODOLOGY
## *Divergence*

What methodology should be used in the human response model? Do you have a preference or recommendation?

- Probit? Performance-based? Toxic load? Other?

### *Civilian*

- SME best guess could be used to determine underlying methodology, if no other basis exists
- Some disagreement over applicability of existing military models to civilian human response

6

## METHODOLOGY
### Consensus

How much insight would you require into the underlying methodology? Underlying data?

- Completely transparent (algorithms)? Black box?

- Model use should not be complicated by efforts at transparency
- Transparency should be provided by documentation.
  - This would be accessed to differing degrees by different users.
    - Operational users (none to moderate)
    - Staff support (none to moderate)
    - Policy users (none to moderate)
    - Clinical users (moderate to complete)
    - Civilian planners (moderate to complete)
    - Reach back / Research (complete)

7

## METHODOLOGY
### Consensus

How much insight would you require into the underlying methodology? Underlying data?

- Completely transparent (algorithms)? Black box?

- Documentation should be comprehensive
  - Methodological process (including algorithms and parameters)
  - Underlying assumptions and variables
  - Vulnerabilities (strengths and weaknesses)
  - Data references
- Methodology must be scientifically defensible, valid, reliable
  - Want to ensure that the data set includes quantified definitions and information vetted by an expert panel and either published or publishable

8

## METHODOLOGY
### *Additional Considerations*

- Transparency mitigates political and legal liability issues
  - Of greater concern for some users than others
- Need to design the model so that components can be changed at a later time when understanding of the response is better

9

# Discussion

# Consensus

10

# METHODOLOGY

## Military Operational

**What methodology should be used in the human response model? Do you have a preference or recommendation?**

- **Probit?, Performance-based?, Toxic load?, Other?**

- Users generally didn't know enough about existing methodologies, and didn't really seem to care
  - "Don't tell me what I don't need to know"
- The methodology must include what is appropriate for the agent and response being modeled
  - Probit, because of the availability of data, but need a time dimension for response
  - Toxic load, for acute response to protracted exposures
  - Performance based, for how well it fits desired response metric …
  - Statistical analysis methodology such as ANOVA for risk calculations and confidence levels
  - One model does not fit all agents, possibly requiring multiple methodologies

11

# METHODOLOGY

## Military Support

**What methodology should be used in the human response model? Do you have a preference or recommendation?**

- **Probit?, Performance-based?, Toxic load?, Other?**

- The amount of what we know (which isn't very much in some cases) is likely to drive the complexity of the models
  - It may be difficult or impossible to dig out original data from unpublished research
- While researchers do not seem to want aspects of the response model methodology to be inputs for all users, they would like to be able to subject them to sensitivity analyses
  - Would like to be able to change the underlying distributions
- Need to design the model so that methodology components can be changed at a later time when understanding of the response is better
- If there are competing methodologies, they should be included in the model; the user should be able to do multiple calculations, if necessary
- Toxic load-based models for protracted exposures and probit- or performance-based models for non-protracted exposures

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# METHODOLOGY

## Civilian

**What methodology should be used in the human response model? Do you have a preference or recommendation?**

- **Probit?, Performance-based?, Toxic load?, Other?**

- Use the best performers for the given scenarios (agents, populations)
- Determine which models worked best in the past for military and other outbreaks and then make those models and underlying assumptions available to civilian users
  - Would help users understand how the models function and
  - Would help users apply models to appropriate situations
- Use the methodology that captures the most information over time
- The math doesn't really matter; more important is "curve-fitting to the base data."
- SME best guess could be used to determine underlying methodology, if no other basis exists
- No preference, as long as methodology is validated/ accredited and defensible

13

# METHODOLOGY

## Military Operational

**How much insight would you require into the underlying methodology? Underlying data?**

- **Completely transparent (algorithms)?, Black box?**

- The collective response was that transparency should be provided by some documentation.
  - This would be accessed to differing degrees by different users.
    - Operational Users
    - Staff Support
    - Reach back / Research
  - This should include a very high level of detail, with comprehensive summaries
    - Methodological process (including algorithms and parameters)
    - Underlying assumptions
    - Vulnerabilities (strengths and weaknesses of models)
    - Data source references
- It must be scientifically defensible, valid, reliable
  - Accredited / Validated by competent authority
  - Tamper proof

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# METHODOLOGY

## *Military Support*

### How much insight would you require into the underlying methodology? Underlying data?

- **Completely transparent (algorithms)?, Black box?**

- The collective response was that transparency should be provided by some documentation.
  - This would be accessed to differing degrees by different users.
    - Operational Users (little to none)
    - Clinical Users (little to none)
    - Staff Support (little to none)
    - Reach back / Research (complete)
  - This should include a very high level of detail, with comprehensive summaries
    - Methodological process (including algorithms and parameters)
    - Underlying assumptions
    - Vulnerabilities (strengths and weaknesses of models)
    - Data source references
- It must be scientifically defensible, valid, reliable
  - Want to ensure that the data set includes quantified definitions and information vetted by an expert panel and either published or publishable

15

# METHODOLOGY

## *Civilian*

### How much insight would you require into the underlying methodology? Underlying data?

- **Completely transparent (algorithms)?, Black box?**

- Most users want transparency made available through documentation
  - This would be accessed to differing degrees by different users.
- Some users want assumptions, variables, and data references made readily available to user
- Others want complete transparency, including algorithms
- A few users find a black box acceptable; don't need insight into methodology
- Some users required validation of model through authoritative organization (such as CDC)

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## 6. TOOL Attributes - Briefing

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Institute for Defense Analyses
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# Defining the Attributes of CBRN Human Response Models

## APPLICATION / TOOL

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 5, 2006

## Sub-Task Objective

*Identify the platforms, programs, formats, and support*

*which the user community feels is necessary for the CBRN Human Response*

APPLICATION / TOOL

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# APPLICATION / TOOL

## Consensus

### What platform(s) should run this application?

- Platform does matter, with different platforms for different users
  - Web based and stand alone are both required by different communities
  - Laptop is a common and available hardware
    - Perhaps be able to export results to PDA
  - Program and platform must meet compatibility requirements

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# APPLICATION / TOOL

## Consensus

### What interface should this application/tool use?

- GUI interface preferred
  - Interface should be as simple as possible
    - Should incorporate default/recommended settings
    - Should provide ability to select alternative inputs (options)
    - Should provide ability to input own data and change the inputs
    - Should include guidance for and ability to input very specific information
- Links to data sources, references, help, and other supporting details requested
- User-friendly tool required

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# APPLICATION / TOOL

***Consensus***

**What program(s) should the tool be compatible with?**

- Exportable inputs and outputs
  - For current event response, model should take real-time data inputs and continuously update
- Particular programs:
  - Windows suite of office applications (Excel, Word, Access, PowerPoint, etc.)
  - Geo-referenced tool: GIS, Arcview, ESRI or other
  - Database tool: Oracle, Access or other
  - Plume models: NARAC, Cameo, Aloha, etc
  - Resource estimation tools: JMAT, etc.

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# APPLICATION / TOOL

***Divergence***

**What program(s) should the tool be compatible with?**

***Military Operational***

- Particular programs:
  - The Critical Infrastructure Tool
  - ABCs (Army Battle Command systems)
  - TRADOC Battle Command System

***Civilian***

- Programs may need to have confidentiality controls in place so that local inputs can be included
- Particular programs:
  - Emergency Operations programs: WebEOC, ETeam, etc
  - Surveillance tools: BioWatch, Health Alert Network (HAN)

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# APPLICATION / TOOL

## Consensus

### What format(s) should be used to present the outputs?

- Need multiple ways to present the data
  - Raw data
  - Graphs, charts, tables
  - Maps, pictures, images
- Output formats will change depending on the audience
  - May need simple graphs and high level numbers for briefing officials
  - Need to be able to develop reports with assumptions, data sources, confidence, and line item data at the analysis level
    - Data and more detailed reports may be needed to legally defend decisions or support policy
- Outputs format needs to be manipulable, but the data itself should not be able to be changed

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# APPLICATION / TOOL

## Consensus

### What level of training would you expect to receive for this tool/model?

- Users clearly recognized that training is required and should be ongoing
  - Model usage is understood to be an expendable skill, so refresher training must be available
  - Roll-outs of previous models have failed due to system complexity and incomplete training
- Training should vary by user-level
  - Train-the-Trainer and Expert Training either onsite or offsite
  - Classroom training for general users
  - Online or computer-based tutorial for refresher training
  - Internal wizard to provide additional assistance
- Multiple training modalities should exist
  - Web-based, computer-based, classroom
- Training should focus on intended uses, such as:
  - Aid in useful scenario development
  - Assess assumptions, results, etc., and take action to correct questionable results

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# APPLICATION / TOOL

## *Consensus*

**What level of support would your activity require for this tool/model?**

- All respondents expected some support
  - 24/7 reachback capability
    - Assistance running the model
    - Assistance in assessing the results
  - Web-based help desk or chat capability
  - Potential off-site modelers to perform modeling, especially in extreme situations
  - Potential need for periodic on-site support to help work through a particular drill/exercise
- Off-hours assistance is vital – "disasters never happen during business hours"

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# APPLICATION / TOOL

## *Additional Considerations*

- Many users suggested having versions for the tool:
  - Expert, intermediate, novice
  - Research, operational (field-expedient), clinical
    - Research and reach-back centers have computing capability to run a complex version on desktops
- Training could be incorporated within existing training centers and/or schools
- Tool and outputs must have some option for secure use
  - For example, both unclassified and classified versions should be available for use on NIPR and SIPR systems

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IDA

# Discussion

# Consensus

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IDA

## APPLICATION / TOOL

***Military Operational***

**What platform(s) should run this application?**

- Platform does matter, with different platforms for different users
  - Web based and stand alone are both required by different communities
  - Laptop is a common and available hardware
    - Perhaps be able to export results to PDA
  - Program and platform must meet compatibility requirements

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# APPLICATION / TOOL

## *Military Support*

**What platform(s) should run this application?**

- Laptop is a common and available hardware
  - Perhaps be able to export results to PDA
- Research and reach-back centers have computing capability to run a complex version on desktops
- Stand-alone version was requested by users

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# APPLICATION / TOOL

## *Civilian*

**What platform(s) should run this application?**

- Web-based application with reachback support and online assistance
  - "Our office would not likely support the tool even if it was mandated and installed"
- Stand alone application available as well for use on PC or laptop
  - Results should be exportable to a PDA

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# APPLICATION / TOOL

***Military Operational***

**What interface should this application/tool use?**

- GUI interface preferred
  - Interface should be as simple as possible
  - Windows based
  - Pull downs and pick lists, plus tabs to get to certain sections.
    - Example: Flight Planning Tool
- Should be user-friendly

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# APPLICATION / TOOL

***Military Support***

**What interface should this application/tool use?**

- GUI interface preferred
  - Interface should be as simple as possible
  - Pull downs and pick lists, plus tabs to get to certain sections.
    - Ability to pick from defaults and type own inputs
- Should be user-friendly

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# APPLICATION / TOOL

*Civilian*

**What interface should this application/tool use?**

- GUI interface preferred
  - Interface should be as simple as possible
  - Default settings, pull downs and pick lists.
    - Must be able to input own data and change the inputs
    - Should include guidance for and ability to input very specific, city-related information
- Should be user-friendly

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# APPLICATION / TOOL

*Military Operational*

**What program(s) should the tool be compatible with?**

- Input and output importable / exportable to common programs.
  - For current event response, model should take real-time data inputs and continuously update
- Able to pull data from web
  - Windows suite of office applications (Excel, Word, Access, etc)
  - GIS or other geo-referenced programs
    - Pull the associated geo-locations, or merge with the geo-locations from other models
  - Oracle or other common database
  - The Critical Infrastructure Tool
  - ABCs (Army Battle Command systems)
  - TRADOC Battle Command System
  - MAT

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# APPLICATION / TOOL

## *Military Support*

### What program(s) should the tool be compatible with?

- Input and output importable / exportable to common programs.
  - Windows suite of office applications (Excel, Word, Access, etc)
  - GIS or other geo-referenced programs
    - Pull the associated geo-locations, or merge with the geo-locations from other models

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# APPLICATION / TOOL

## *Civilian*

### What program(s) should the tool be compatible with?

- Exportable inputs and outputs
  - For current event response, model should take real-time data inputs and continuously update
  - Programs may need to have confidentiality controls in place so that local inputs can be included
- Particular programs:
  - Windows suite of office applications (Excel, Word, Access, Powerpoint, etc)
  - Geo-referenced tool: ArcviewGIS, ESRI or other
  - Database tool: Oracle, Access or other
  - Emergency Operations programs: WebEOC, ETeam, etc
  - Plume models: NARAC, Cameo, Aloha, etc
  - Local tools for surveillance and resource tracking

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# APPLICATION / TOOL

***Military Operational***

**What format(s) should be used to present the outputs?**

- Need flexibility in output - Output formats will depend on the nature of the response set
  - Graphical and tabular outputs, histograms, pie charts, …
    - Have to have tabular data as backup
  - Tool should help in communication with Commanders
    - Text report with assumptions, etc
    - FAQ sheets pertinent to event
    - Graphs (and other output) need to be manipulable (change colors, titles, highlights, etc.)
  - Both unclassified and classified versions to be used on NIPR and SIPR systems

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# APPLICATION / TOOL

***Military Support***

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# APPLICATION / TOOL

*Military Operational*

**What level of training would you expect to receive for this tool/model?**

- Clearly recognized that some level of training will be required
  - Program should be intuitive, but not so much that anyone can pick it up and think that they are getting the right answers
  - Concern expressed about the perishability of knowledge, but this may be mitigated by the intuitiveness of the tool to begin with
- Multiple training modalities
  - Web based, Computer based, Didactic (perhaps at existing training centers)
- Multiple training levels
  - Initial fielding training as well as Sustainment training
  - Should probably think in terms of 2 types of users:
    - Basic User – Operational Unit, Planning Staff (1 day?)
    - Advanced User – Planning Staff expert, Reachback (3-5 days?)
- Expect that
  - Most users will get some basic training on the tool, but
  - Then will need to be able to call back to a reachback capability for more detailed questions, issues

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# APPLICATION / TOOL

## *Military Support*

**What level of training would you expect to receive for this tool/model?**

- Clearly recognized that some level of training will be required
  - Program should be intuitive, but not so much that anyone can pick it up and think that they are getting the right answers
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  - Most users will get some basic training on the tool, but
  - Then will need to be able to call back to a reachback capability for more detailed questions, issues

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# APPLICATION / TOOL

## *Civilian*

**What level of training would you expect to receive for this tool/model?**

- Training is vital and should be continually renewed
  - Roll-out of previous models has failed due to system complexity and incomplete training
  - Training and model usage is understood to be an expendable skill, so refresher training must be available
- Training should focus on intended uses
  - Aid in useful scenario development
  - Assess assumptions, results, etc and take action to correct questionable results
- Training should be varied by user-level
  - Train-the-Trainer and Expert Training either onsite or offsite
  - Classroom training for general users
  - Online or computer-based tutorial for refresher training
  - Internal wizard to provide additional assistance

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# APPLICATION / TOOL

## *Military Operational*

**What level of support would your activity require for this tool/model?**

- All respondents expected some support
  - Web-based customer support with monitoring personnel
    - Help Desk and POC
  - Reachback (at sponsoring agency or DTRA)
    - 24/7 runs ASAP after request.
  - Periodic on-site support to help work through a particular drill/exercise

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# APPLICATION / TOOL

## *Military Support*

**What level of support would your activity require for this tool/model?**

- Ideally would want a modeling expert to be available to help the researchers use the models.

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# APPLICATION / TOOL

*Civilian*

**What level of support would your activity require for this tool/model?**

- All respondents expected some support
  - 24/7 Reachback capability
    - Assistance running the model
    - Assistance in assessing the results
  - Web-based virtual help-desk or chat capability
  - Potential off-site modelers to perform modeling, especially in extreme situations
- Off-hours assistance is vital – "disasters never happen during business hours"

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## 7. Way Ahead - Briefing

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# Defining the Attributes of CBRN Human Response Models

# WAY AHEAD

Carl A. Curling, Sc.D.
Julia Burr
Deena Disraelly
Lusine Danakian
**Institute for Defense Analyses**
December 5, 2006

## Task Objective

*The US is planning to develop a coordinated CBRN Human Response Model*

- Coordinate the attributes specified by:
  - USDoD (DTRA)
  - NATO via NBCMedWG (OTSG)
  - DHHS (OPHEP)
- Component of future applications:
  - Joint Operational Effects Federation (JOEF)
  - DHHS analytic tool
  - NATO Allied Medical Publication 8 (AMedP-8)

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## Interviews – DoD & Other Military

- NATO – ACO/ACT
- Commands
  - CENTCOM
  - JFCOM
  - PACOM
- Joint
  - AFRRI
  - ASBP
  - DARPA
  - DTRA
  - JRO
  - JTF-CS
  - SOCPAC
  - USFORSCOM
  - USUHS
- Service Resources
  - Army
    - 3rd Army
    - AMEDDC&S
    - ARNORTH
    - MEDCOM
    - MRMC
    - OTSG
    - USAMRICD
    - USAMRIID
    - USACHPPM
    - USANCA
    - USARPAC
  - Marine Corps
    - MARFORCOM
  - Navy
    - 2nd Fleet
    - 3rd Fleet
    - BUMED
    - COMPACFLT
    - FFC
    - NHRC
    - NSW
  - Air Force
    - 13th AF
    - AFMS
    - AFRL
    - AFIOH
    - USAFSAM

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## Interviews – Civilian Agencies

- DHHS
  - CDC
    - CCID/NCID
    - COTPER/DSNS
    - COGH/OGPSS
- DOT
  - FAA
  - PHMSA
  - NHTSA
- DHS
  - FEMA
- Cities
  - Boston
  - New York City
  - Los Angeles
  - San Diego
- National Labs
  - Los Alamos
  - Sandia

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## Interviews – Still to Come

- DoD & Other Military
  - NORTHCOM
  - STRATCOM
  - ARNORTH
  - Joint Warfighting Center
  - MEDCOM
  - NEHC
  - TRADOC
  - TRAC/CAC
  - USAF
    - AFMOA/SGXH
  - USCG
  - USMC
- Civilian
  - DHHS
    - OPHEP
    - CDC
    - AHRQ
  - DHS
    - FEMA
  - DOJ/FBI
  - EOP
  - State Department
  - VA
  - Cities
    - Denver
    - Washington D.C.

**Who else should we talk to?**

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## Timeline

- December 4-5 – Interagency conference
  - Presentations on attributes
  - Consensus discussions
- December – January: Complete interviews
- Late December:
  - Draft report on attributes
- February:
  - Conference notes available to attendees & interviewees
  - Final report on attributes submitted to sponsors

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# Questions?

## Contact


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**14. ABSTRACT**

A human response model, also known as a casualty estimation model, is usually one component of a larger suite of models. For our purposes, the human response model is used to estimate the number of people who may be expected to require medical treatment, as well as the number of anticipated fatalities due to the insult over time resulting in personnel exposed to some event involving Chemical, Biological, Radiological, or Nuclear (CBRN) agents (or influenza). In December 2006, members of the civilian and military communities met to discuss the model attributes that should be considered for inclusion in a coordinated human response model—a single model for use by planners and responders at all levels (both military and civilian), so that every user can expect to get a similar answer for the same question.. This paper summarizes the conversations during the conference and provides the applicable briefings.

**15. SUBJECT TERMS**

Modeling, model attributes, human response, casualty estimation, chemical warfare, biological warfare, nuclear warfare

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