

## Technological Advancements in Managing Emergencies and Disasters

### Use of Regional Telemedicine to Provide Critical Care during the H1N1 Pandemic

Christian Sandrock, MD, MPH, FCCP

Assistant Professor of Medicine Medical Director, Intensive Care Unit  
Division of Infectious Diseases Division of Pulmonary and Critical  
Care Medicine, UC-Davis School of Medicine, Davis, California  
USA

Telemedicine provides clinical and scientific expertise to rural and remote areas when subspecialists are unavailable. It also can provide technical and educational expertise across a large region in a just-in-time manner. During the H1N1 outbreak in California, telemedicine was used to provide clinical, technical, and public health expertise to a wide range of healthcare facilities. This expertise included critical ventilator management, infection control and prevention, laboratory and diagnostic support, public health support (non-pharmacologic measures), and patient consultation. The most prominent use was the respiratory care provided across the healthcare spectrum, from emergency medical services to alternate care sites to the hospital. Finally, this process of consultation was monitored and supported by regional and state public health officials, providing greater support for resource management and surge capacity planning. The infrastructure and coordination of telemedicine during the H1N1 outbreak, including how to care for patients at multiple sites, how to improve sub-specialist force multiplication (e.g., critical care), and how to link public health response with healthcare facilities will be discussed.

Objectives include:

1. Understanding the role of telemedicine in force multiplication;
2. How to distribute mass information or clinical care changes across the healthcare and public health system using telemedicine; and
3. Using case scenarios and collected data, understand how telemedicine provided real time information and patient care during the H1N1 outbreak.

Keywords: cooperation; H1N1; regional; pandemic; telemedicine  
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### Comparison of Novel Cooling Methods for Prevention of Hyperthermia in CBR Responders in Tropical Northern Australia

I. Norton,<sup>1,2</sup> M. Brearley,<sup>3</sup> K.D. Hrbabar,<sup>1</sup> T. Trewin,<sup>4</sup>  
C. Mitchell<sup>1</sup>

1. Royal Darwin Hospital, Darwin, Australia
2. National Critical Care and Trauma Response Centre, Darwin, Australia
3. Northern Territory Institute of Sport, Darwin, Australia
4. Northern Territory Fire and Rescue Service, Darwin, Australia

**Objectives:** The objectives of this study were to assess the physiological and perceptual responses of healthcare workers to a chemical, biological, or radiological (CBR) training exercise in tropical conditions, and to compare the effectiveness of four cooling methods on core body temperature.

**Methods:** Sixty volunteer participants, all of whom were healthcare workers (predominantly doctors and nurses) were randomized into four cohorts: (1) Shade; (2) Ice Vest; (3) Water Immersion; and (4) Crushed Ice Ingestion). The participants were matched for body mass index (BMI). The exercise consisted of triaging, resuscitating, transporting and decontaminating real weight manikins while dressed in level-3 personal protective equipment (PPE) in field conditions (mean outdoor wet-bulb globe temperature of 31.4°C) for a total of three hours, alternating work/rest phases every 30 minutes. Cohort 2 wore ice vests under their PPE during the active phase, and then rested in the shade. During the cooling phase, Cohort 1 rested quietly in the shade, Cohort 3 were immersed in large tubs of water at 25°C and Cohort 4 ingested 7.5mL.kg<sup>-1</sup> body mass of crushed ice. All four groups had ad libitum access to fluids. An ingestible telemetry pill permitted measurement of core temperature throughout the exercise, while tympanic temperature, heart rate, blood pressure, subjective thermal sensation, and thermal discomfort ratings were recorded periodically throughout the cooling phase.

**Results:** The peak core body temperature of 40.8°C was observed, with three participants recording temperatures above 40.4°C during the study. Overall, the participants that wore the ice vests during the active phase and those that undertook water immersion during the rest phase stored less heat during their active phases. Participants in both of these groups performed tasks more effectively and had less muscle soreness the following day.

**Conclusions:** This first-of-its-kind study was performed in tropical conditions in the field, with healthcare workers wearing impermeable PPE during a realistic CBR incident scenario. The study confirmed that CBR responders are at risk of hyperthermia in these conditions. The authors were able to extrapolate work/rest ratios in hot and humid conditions that may be used safely in healthcare workers with a wide range of BMIs and background fitness.

Keywords: Australia; chemical, biological, and radiological; cooling methods, core body temperature; hyperthermia  
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### Science and Technology Solutions to Support Emergency and Disaster Preparedness and Response

Jalal Mapar

Program Manager Science and Technology Directorate, Department of Homeland Security, USA

With society becoming ever more complex, and the ability and need to cross and transcend traditional national and international boundaries, reliance on advanced technology and a greater understanding of science is becoming more important in the preparedness for, response to, and recovery from (mitigation of) emergencies and disasters. Consequently, responders must be more educated, better prepared, more agile, and sophisticated, and so too must their support equipment and the technologies upon which they rely. To support this, many nations and agencies have various initiatives to better understand the needs of the emergency and disaster response community. Ranging from lighter, cheaper, and more effective personal protective equipment, to improved situational awareness through enhanced com-

munication, to changes and optimization of command and control using virtual reality and immersive environments, a wide array of emerging and maturing technologies are being adapted and deployed for the use of emergency and disaster personnel.

The US Department of Homeland Security's (DHS) science and technology is in the forefront of developing innovative technologies to provide emergency managers and operators a capability to effectively, economically, and rapidly verify and validate response tactics, plans, and procedures. These technologies also are used to conduct "what-if"-type analyses prior to an incident (preparedness, analysis, and training) and during/after an incident (operational, lessons learned). The science and technology approach to developing these technologies is to provide training and exercises (real time) and analysis of alternative response tactics (non-real time). As part of this research effort, DHS is developing a common framework to allow for the rapid integration of existing incident-related modeling and simulation tools and use of virtual worlds to enhance the user experience. This technology is intended to enhance the understanding of the impacts and consequences of complex incidents to improve planning and response for increased effectiveness of procured resources and reduce the loss of life and property.

**Keywords:** emergency; disaster; preparedness; response; science; technology

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### Federated Modeling and Simulation Architecture to Enhance Preparedness and Response

*Heidi Ammerlahn*

Sandia National Lab, USA

Increasingly, modeling and simulation technologies are proving to be a cost-effective method of improving preparedness at the incident response and the community level. Currently, there is a plethora of modeling and simulation technologies, methodologies, and techniques, each intended to support a specific capability. In regards to preparedness and response at the tactical and command control level, many of these models must be brought together to provide an integrated capability. The current challenges include managing interfaces, scalability, interoperability with commercial and government tools, and the use of gaming technologies. An innovative approach to solving this complex integration problem will be presented, and a prototype solution that addresses modeling and simulation interoperability and scalability will be showcased.

**Keywords:** modeling; preparedness; response; simulation

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### Making Exercises More Useful and Relevant Through Application of Modeling and Simulation Technology

*Dr. Keith Holtermann*

Director, National Exercise and Simulation Center, National Exercise Division, Federal Emergency Management Agency, Department of Homeland Security, USA

The (US) National Exercise Simulation Center (NESC) is a Congressionally-mandated, state-of-the-art training and

exercise facility within the Federal Emergency Management Agency (FEMA) Headquarters. It is designed to be a state-of-the-art, scalable, flexible, simulation center to accommodate a wide range of services. The NESC also supports the all-hazards preparedness and response mission through employing a mix of live, virtual, and constructive simulations. The NESC is an important tool for elected officials and emergency support providers at all levels of government and supports NEP events involving partners from federal, state and local government, non-governmental organizations, and the private sector. The NESC is a forum for interagency planners to test their plans (e.g., annual hurricane plans, pandemic influenza plans) by providing realistic incident scenarios through which partners can identify gaps and determine courses of action. This presentation will describe NESC, its capabilities, use of technologies, and its use within FEMA as a key supporting element of the National Level Exercises in the upcoming years.

**Keywords:** exercises; modeling; National Exercise Simulation Center; simulation; technology

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### International Cooperation in Bringing Technology Out of the Laboratory and into the Field

*Dr. Eric Stern*

Director, CRISMART National Defense College, Sweden

CRISMART is a leading center of competence in the field of crisis management. CRISMART fosters knowledge about national and international crisis management and acts as a bridge between practitioner and researcher communities in an effort to strengthen Swedish and European crisis management capability. CRISMART's research activities target various societal sectors using a number of theoretical and analytical tools to shed light on preparedness and capacity to mitigate acute contingencies. CRISMART's research is headed by the staff in Stockholm, and conducted in collaboration with partners in Sweden and around the world. All of CRISMART's analytical support and educational activities are based on scientifically documented experiences of national and international crisis management. Since the mid 1990s, CRISMART has trained decision-makers at all levels and in a number of sectors in Sweden and abroad. This presentation will describe CRISMART and associated research that is applied to preparedness and response scenarios.

**Keywords:** cooperation; international; research; technology

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### National Center for the Study of Preparedness and Catastrophic Event Response

*Dr. Lynn Goldman, MD, MPH*

National Center for the Study of Preparedness and Catastrophic Event Response, Co-Principal Investigator Johns Hopkins University School of Medicine, Baltimore, Maryland USA

The mission of the (US) National Center for the Study of Preparedness and Catastrophic Event Response (PACER) is improve the nation's preparedness and the ability to respond in the event of a high-consequence disaster, and alleviate the effects of the event by developing and disseminating