Session B5.0
Title: **Laboratory Research**
Moderator: Jeffrey Schiffman

B5.1
Title: **Effect of first receiver protective ensemble on range of motion and postural balance**
Authors: Sharon Chiou, Joyce Zwiener, Mathew Hause, John Powers, Darlene Weaver, Robert Chetlin, Mahmood Ronaghi, Ridenour Marilyn

Objectives: Healthcare workers are at risk for occupational exposures to chemical, biological, or radiological materials when treating contaminated patients, particularly after mass casualty incidents. When handling victims, healthcare workers normally wear the personal protective equipment (PPE) recommended in an OSHA Best Practices document for hospital-based first receivers. Traditionally, the design of PPE focuses on the physical and mechanical properties of materials, with very few considerations of usability. The bulky PPE ensemble can restrict mobility, limit effective emergency response, and increase risks for overexertion and slip-trip-fall injuries. The objective of this study was to quantify the barriers to the use of first receiver ensembles by evaluating ergonomic and biomechanical stresses imposed on the wearers.

Methods: This study evaluates the effect of first receiver ensembles on range of motion (ROM) and postural stability. Healthcare workers (N=24) who had at least 12 months of experience wearing surgical masks or N-95 respirators were recruited. The test ensemble included a 3M Breathe Easy Powered Air-Purifying Respirator system, a double layer of gloves, boots, and a Tychem® suit. Measurements of ROM at the shoulders, elbows, trunks, hips, and knees were taken for each subject while wearing PPE or regular clothing (T-shirt and shorts) using a universal goniometer. Postural stability, measured using a Tekscan HR Mat™, was assessed under the experimental conditions of subjects' eyes either open or closed, while standing on either a firm surface or a four-inch foam mat.

Results: The use of PPE had a significant effect on all movements. ROM capability appeared to decrease consistently across all joints. The most restricted areas included shoulders and hips in the frontal plane with more than 30% decrease in shoulder and hip abduction. The use of PPE produced higher sway area and sway length, suggesting increased muscular activity is required to maintain balance.

Conclusions: This study demonstrated that ROM and postural stability was affected by the use of PPE. Future study is needed to examine dynamic stability during decontamination operations. Findings from this study will be used to recommend safer work practices and PPE design to improve the usability of first receiver PPE.

B5.2
Title: **Stability of a mast climbing work platform during fall arrest**
Authors: Bryan Wimer, Mat Hause, Christopher Pan, Tim Lutz

Mast climbing work platforms (MCWPs)-mast climbers-are a type of elevating construction equipment with a powered drive unit that propels a work platform up and down a vertical mast structure. MCWPs are being used more frequently in the United States and are a potentially safe and configurable alternative to traditional tube-and-coupler or system scaffolding. An estimated 22,000 MCWPs are in use in the United States [O'Shea, February 2014], with roughly 70% of those being used daily. Freestanding variations of MCWPs offer mobility and can readily be moved around job sites. These non-anchored MCWPs can be assembled to a working height of up to 45 feet, but under OSHA regulation (1926.451 (g) (1) (vii)), it is only necessary to wear a fall-arrest protection system when an open edge is present. This presents a safety concern for fall exposure. A National Occupational Research Agenda feasibility study investigated the stability of a freestanding, 45-foot mast climber during a fall-arrest condition. A Fraco ACT8 mast climber was erected in its largest freestanding configuration (45 feet tall with 30-foot-long platforms on each side of the mast). A fall-arrest condition was created by dropping an Advanced Dynamic Anthropometric Manikin under three test conditions representing common exposures. Arresting force at the anchor point and platform displacement in the vertical direction were measured. The maximum arrest force under the test conditions was well within the ANSI Z359.1-2007 standard. The maximum initial vertical platform displacement occurred on the unloaded platform condition and was recorded to be 4 inches over an approximate 0.3-second time frame. During each of these tests, the overall stability of the MCWP remained intact. It was noted that if the outriggers were not properly placed according to the manufacturer's recommendation, then the unit could become unstable. Additionally, due to platform movement during the fall-arrest condition, a worker could be exposed to fall hazards if not properly secured.

B5.3
Title: **The design of a universal rig for supporting large hammer drills to reduce injury risk**
Authors: David Rempel, Alan Barr

Objectives: Drilling holes into concrete with heavy hammer and rock drills is one of the most physically demanding tasks performed in commercial construction and poses risks for musculoskeletal disorders, noise

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