

RAPID ASSESSMENT OF CLOTHING AND EQUIPMENT USING ADVANCED THERMAL SIMULATION TO LIGHTEN THE THERMAL LOAD

2015 Human Systems Conference

"Human Systems: Maintaining Our Physical Edge, Enabling Our Cognitive Edge"
Protection, Sustainment and Physical Performance (PS&PP)

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Overview

- Background
- Current Practices
- Bridging the Gap
- Next Steps



Background



Clothing₂



Environment₃

Thermal Load



Activity Level₁



Equipment/PPE₄

1: <https://www.flickr.com/photos/peosoldier/4997230074/> 2: <http://www.af.mil/shared/media/photodb/photos/040722-f-2352g-003.jpg>

3: <https://www.flickr.com/photos/peosoldier/3879776589/> 4: http://www.navy.mil/view_image.asp?id=24320/

Background

⦿ Rapid Response Challenge: Ebola

“-PROBLEM

*On the front lines of the Ebola epidemic, health care workers face many obstacles in providing the timely care to patients that is required to prevent the virus from spreading—from **heat stress** caused by the personal protective equipment (PPE) they wear, to lengthy infection control measures that leave no room for error, to communities reluctant to seek care.*

-CHALLENGE

*Develop new practical and cost-effective solutions to improve infection treatment and control that can be **rapidly deployed** (1) to help health care workers provide better care and (2) transform our ability to combat Ebola.” USAID Fighting Ebola BAA*

*Issued: October 2014 – First round
final decision: December 12, 2014*

Current Practice: Thermal

Design

PRODUCT DESIGN

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HOTPLATE

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THERMAL MANIKIN

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HUMAN SUBJECT TESTS

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FIELD TRIALS / SALE / ISSUE

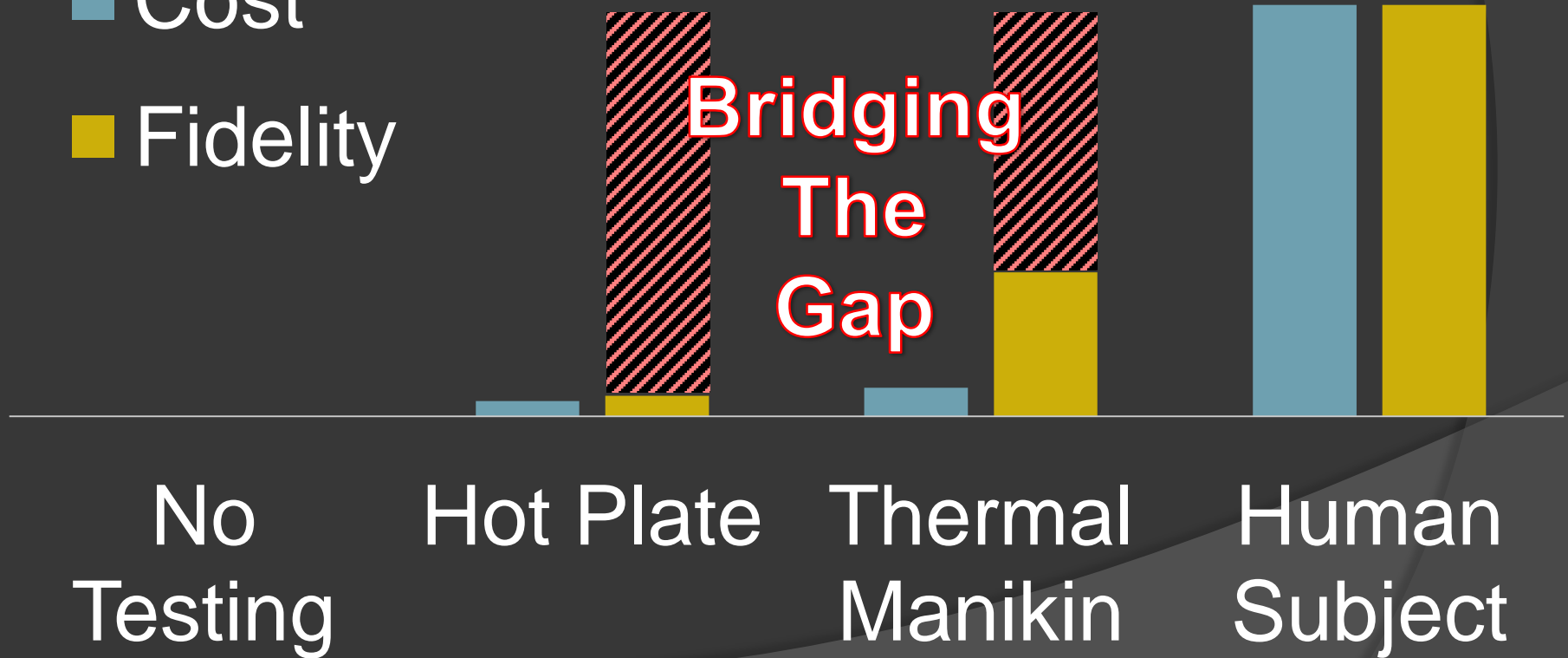


Current Practice

Cost vs. Fidelity for one test

■ Cost

■ Fidelity



Bridging the Gap

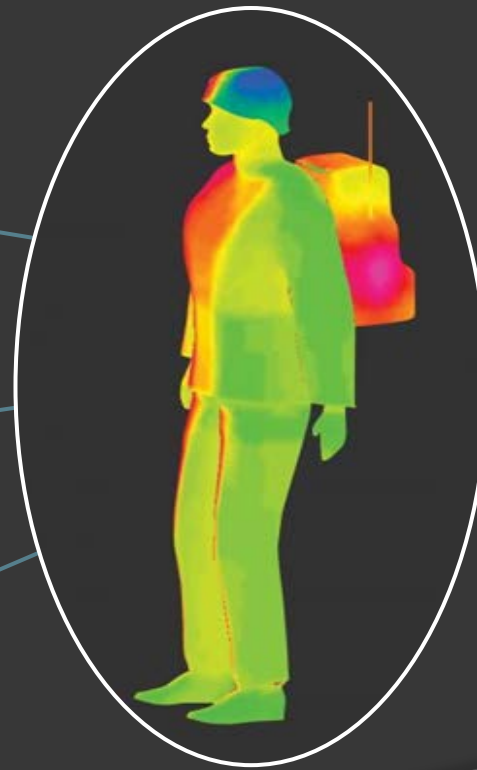
- Two ways to evaluate human thermal effects with simulation:
 1. Simulation of human in various virtual thermal environments
 2. Direct simulation with physiologically controlled manikin

Bridging the Gap: Human Thermal Simulation

Thermal Manikin/
Hotplate

Human
Parameters

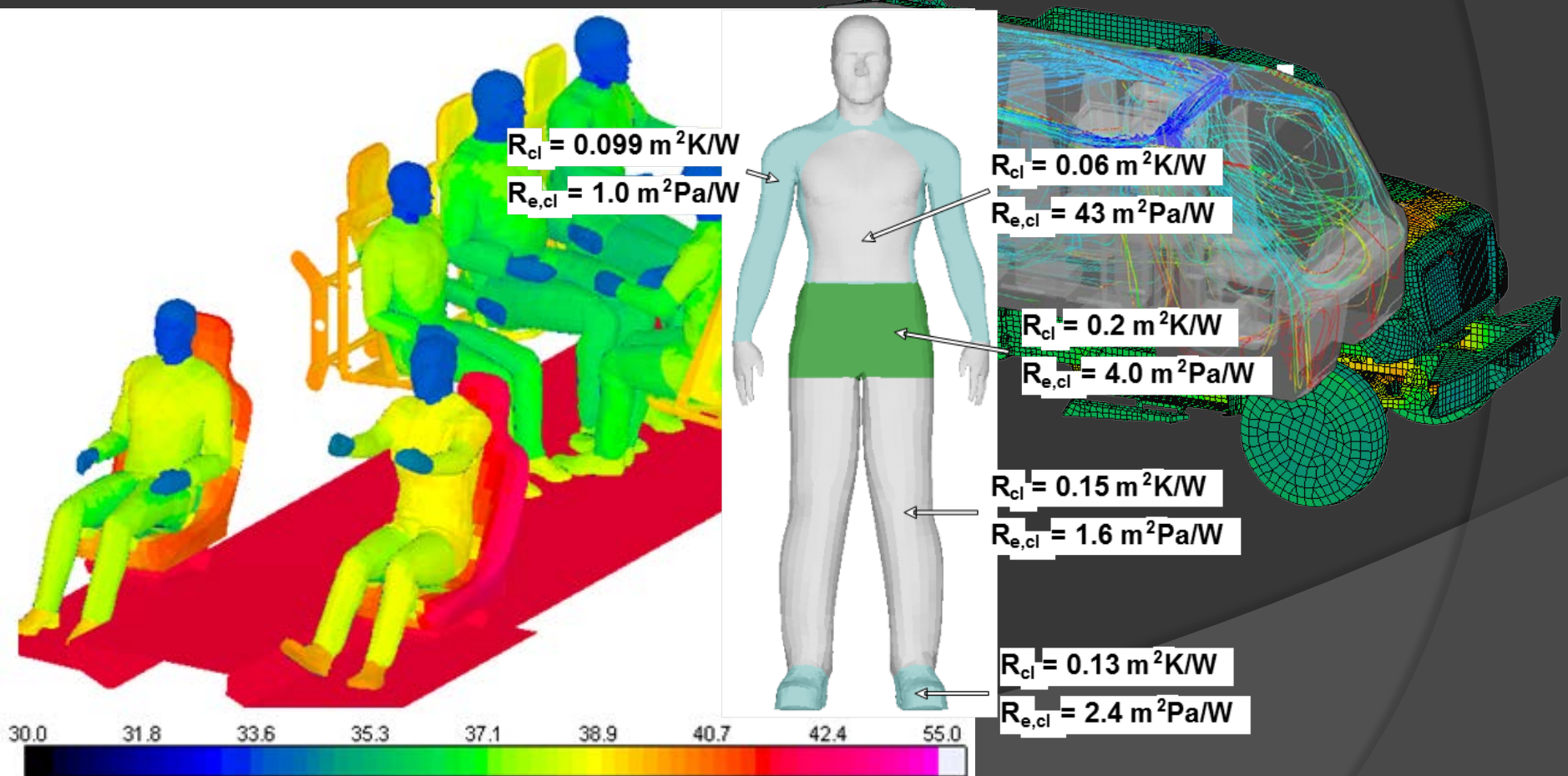
Environmental
Conditions



**HUMAN
RESULTS**

Bridging the Gap: Human Thermal Simulation

Thermal and Evaporative Resistance



Bridging the Gap: Physiologically Controlled Manikin

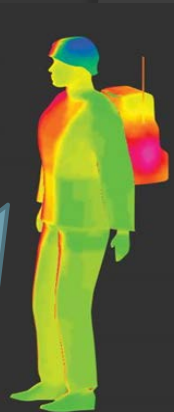
- Manikin is placed in chamber controlled at desired environmental conditions in desired clothing and equipment
- Human inputs are supplied to control program
- Manikin changes skin temperature and sweat rate to simulate human
- Provides human response characteristics to experimenter

Next Steps: Thermal Area

- Develop metrics for warfighter performance vs. thermal load
- Employ in series or parallel with existing task simulation programs

Next Steps: Our Research

- Further the understanding of the relationships between
 - simulation
 - manikin measurement
 - human subject results



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An objective method for screening and selecting personal cooling systems based on cooling properties

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