

UNITED STATES ARMY AEROMEDICAL RESEARCH LABORATORY



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## **Enroute Care in Confined Spaces: Medic Posture Study**

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Amy Lloyd, Rachel Kinsler, Kerri Caruso, Laura Kroening, &  
Jeff Molles

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<b>14. ABSTRACT</b> The confined space of common medical evacuation (MEDEVAC) configurations requires strenuous positions and painful postures of Critical Care Flight Paramedics (CCFPs) during patient loading and unloading during en route care. The goal of this study was to identify areas for design improvements or loading techniques to limit awkward or painful postures exhibited by the CCFP that may lead to injury or musculoskeletal disorders. Subjects performed patient loading and unloading on a simulated MEDEVAC interior while motion data was collected through a reflective marker-based motion capture system. The data from the litter pan position evaluations document was examined to identify movements or postures that cause pain or discomfort. Participants were asked to rate the difficulty on a scale of 1 to 5, with 1 meaning completed without any awkward postures and 5 meaning the trial required constant awkward postures. The data shows that for all of the litter pan positions there was at least one posture mentioned as uncomfortable, and one area of the body mentioned as being negatively affected. These findings will contribute to the development of future MEDEVAC platforms and help develop strategies to prevent injuries to the CCFPs during patient loading and unloading procedures.					
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# En Route Care in Confined Spaces: Medic Posture Study

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# Acknowledgements



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In 2019, the U.S. Army Aeromedical Research Laboratory (USAARL) conducted a survey to investigate the painful postures and resulting injuries of en route care providers while working in the confined space of common medical evacuation (MEDEVAC) platforms.\*

- 87% reported suffering lower back injuries
- 60% responded that the configurability, litter system, cabin ergonomics, compartment size, patient loading capability, and personal protective gear negatively affected the mission

\*Conti, S., Kroening, L., Kinsler, R., Lloyd, A., & Molles, J. (2019). *Optimal physical space for en route care: Medic posture and injury survey results* (USAARL Technical Report No. 2019-19). U.S. Army Aeromedical Research Laboratory.



## Objective



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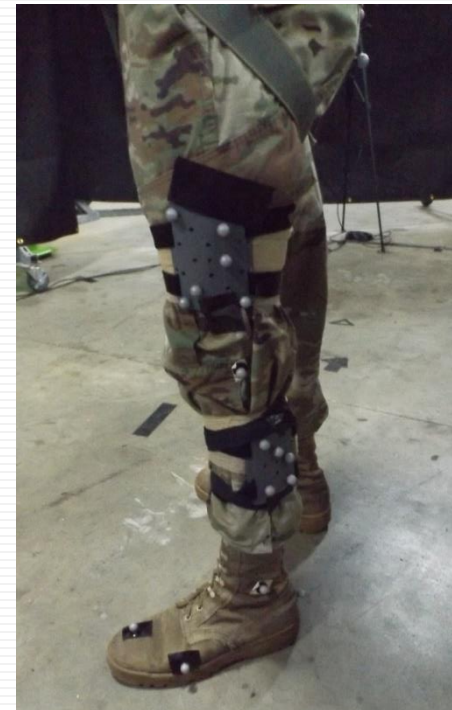
The goal of this study was to characterize the postures associated with patient loading and unloading on MEDEVAC platforms.

The data will be used to identify areas for design improvements or loading techniques to limit awkward or painful postures exhibited by the medics that may lead to injury or musculoskeletal disorders (MSDs).



Motion-tracking cameras were used to collect joint angle data from 17 subjects.

Subject Criteria: U.S. Army, Reserve or National Guard Soldiers, in general good health, no medical conditions that could be affected by lifting, and not pregnant





Subjects loaded and unloaded a 245-pound (lb) manikin into the:

- Basic Medical Interior (BMI)
  - 3 litter positions (Top, Middle, and Bottom)
- Interim MEDEVAC Mission Support System (IMMSS)
  - 2 litter positions (Top and Bottom)



BMI



IMMSS



# Methods



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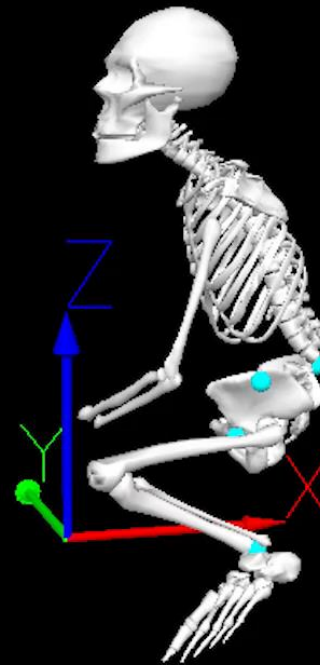
# Results



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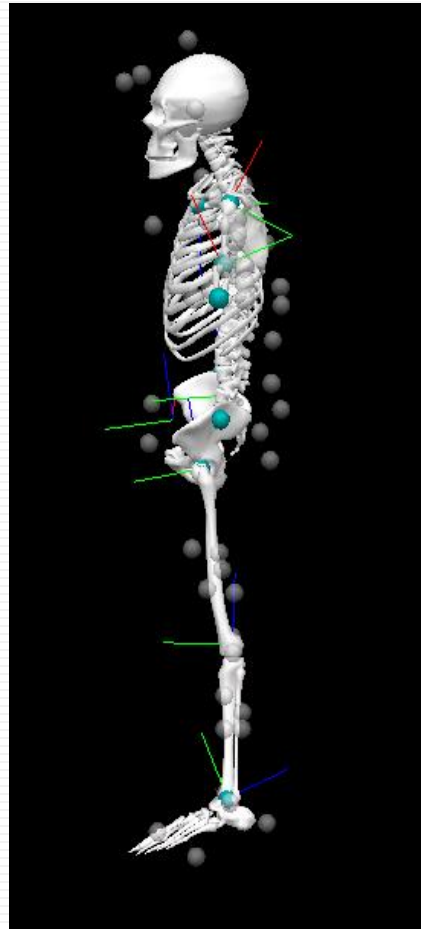
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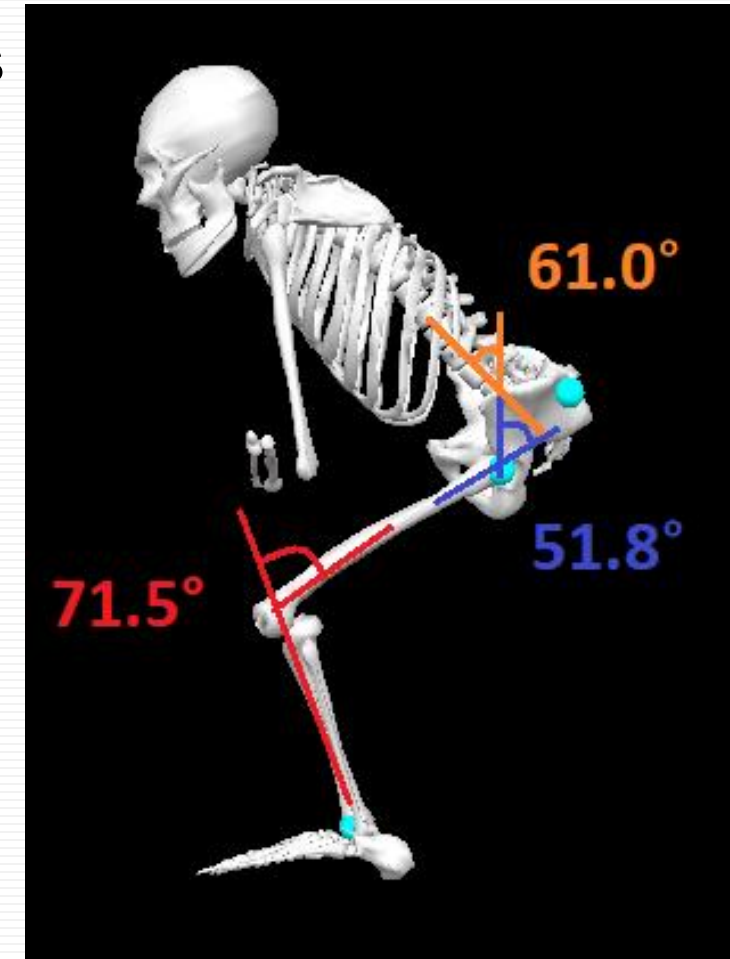
The joint angles examined in the study were:

- Back
- Hip
- Knee



The overall average joint angle for all configurations and all subjects was:

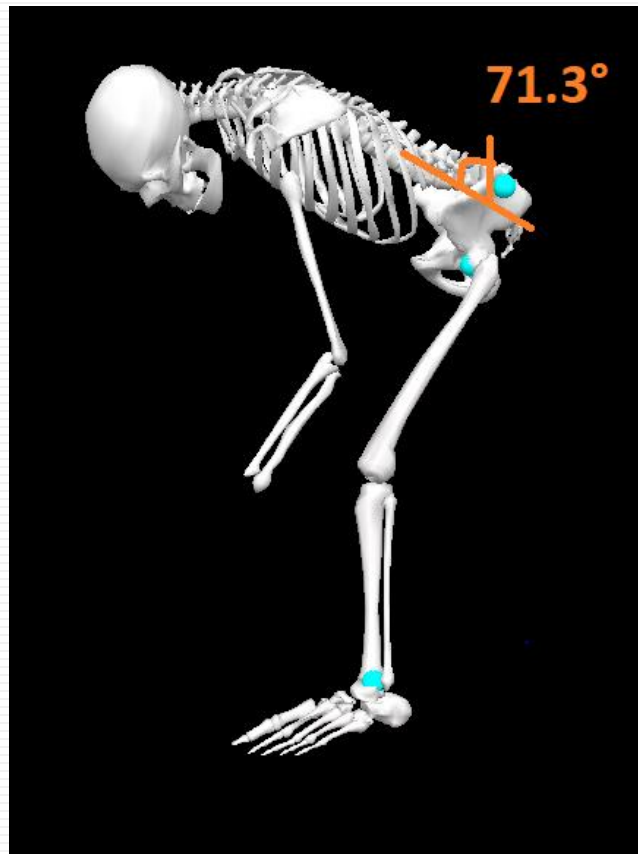
- Back Angle: 61.0°
- Hip Angle: 51.8°
- Knee Angle: 71.5°



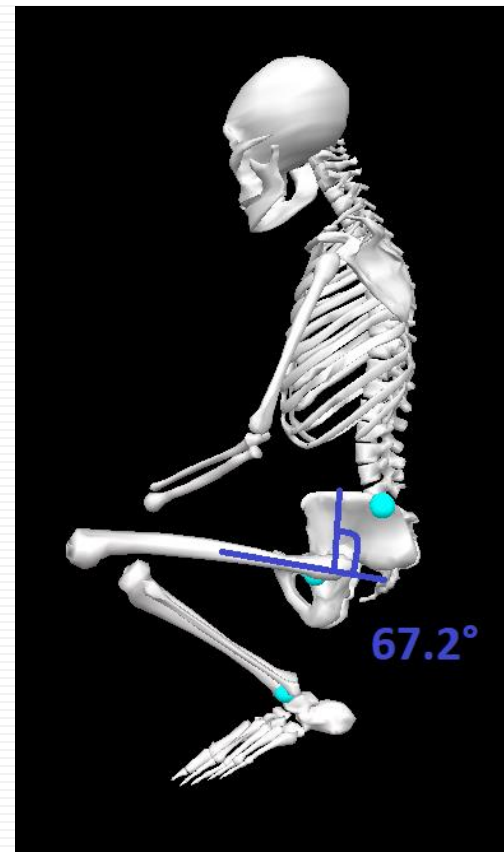


The overall average maximum for each joint angle were:

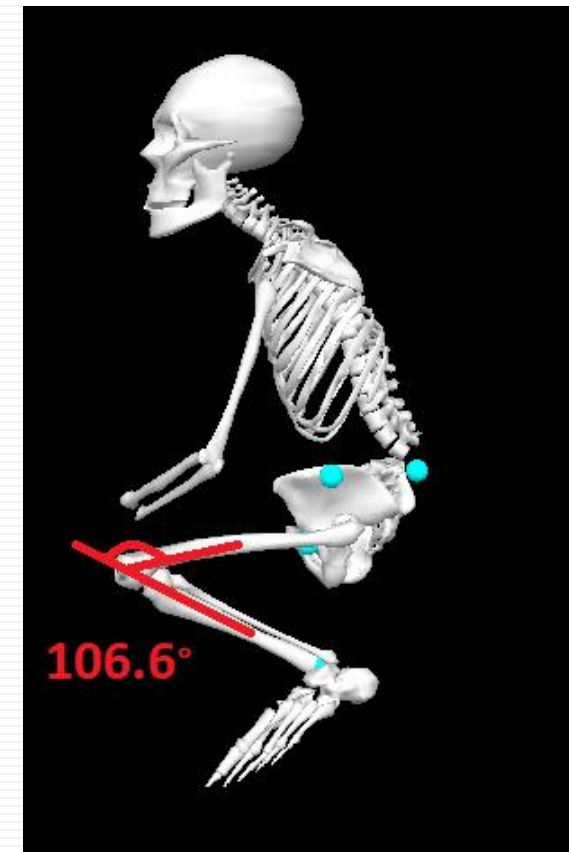
Back: 71.3°



Hip: 67.2°



Knee: 106.6°





Question 1. Rate the difficulty of the trials on a scale from 1 to 5.

The IMMSS top litter pan had the highest rating, followed by the BMI middle litter pan.

- IMMSS top litter pan has a loading height of 24 inches from the floor of the aircraft.
- BMI middle litter pan is impeded by the top litter pan.

Litter Pan Configuration	Average Rating (1 = No Awkward Postures, 5 = Constant Awkward Postures)	Standard Deviation
IMMSS Top	3.44	1.00
BMI Middle	3.32	0.98
BMI Bottom	3.27	1.28
BMI Top	2.65	0.70
IMMSS Bottom	2.79	0.92

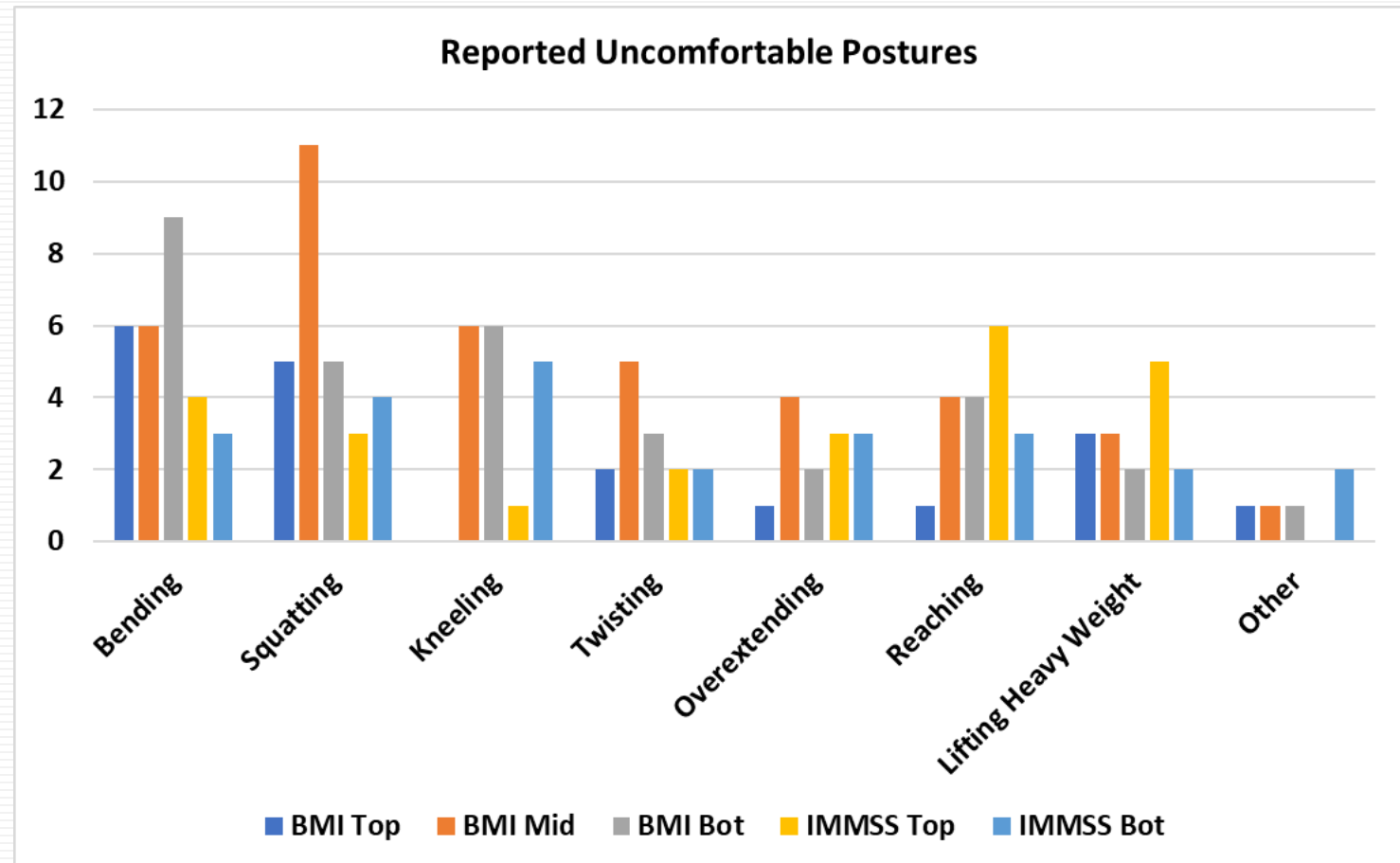


## Question 2. Which movements were painful or uncomfortable during testing?

83% of subjects reported bending caused discomfort

65% of subjects reported squatting caused discomfort

53% of subjects reported kneeling caused discomfort



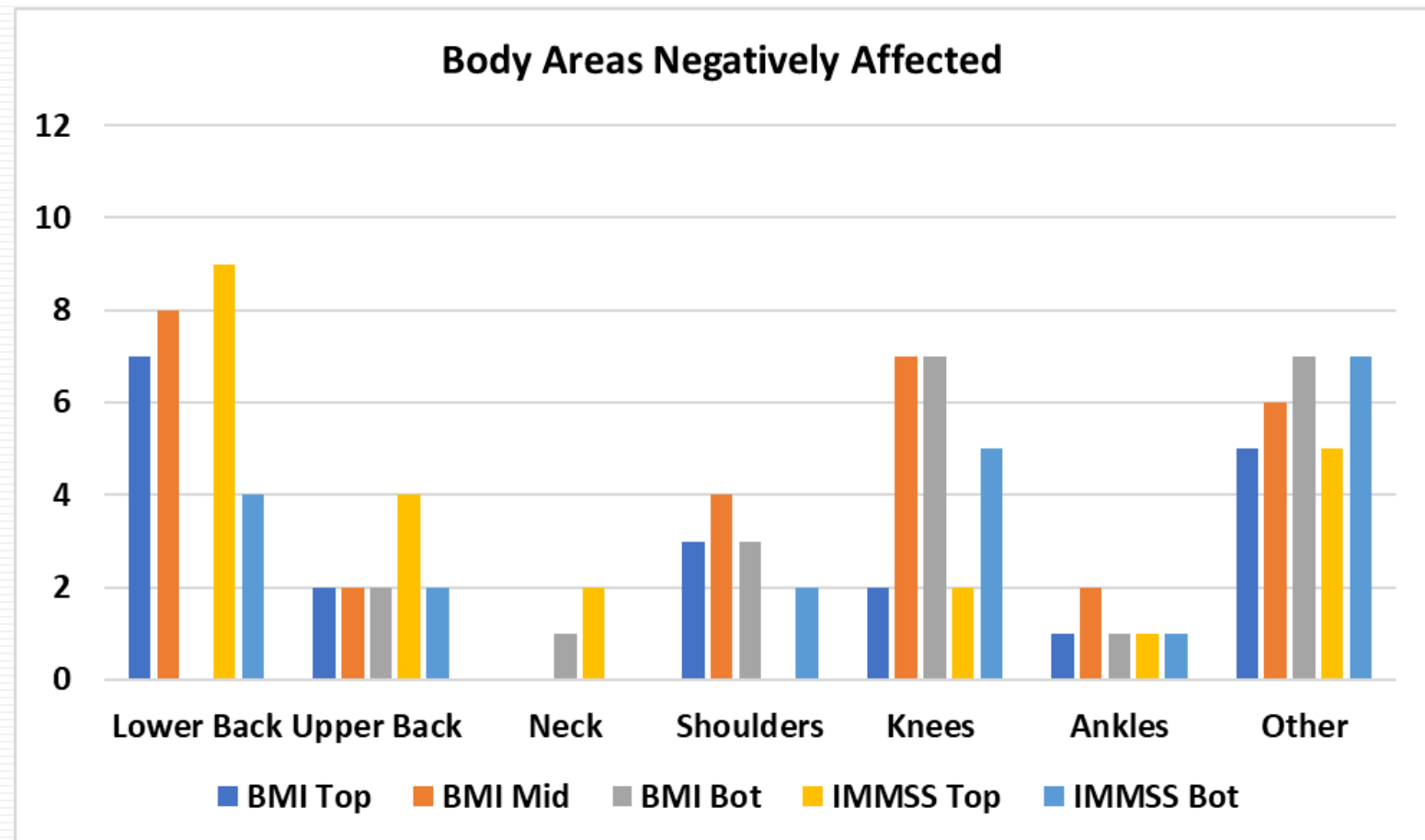


# Question 3. Which areas of the body were negatively affected?

77% of subjects reported lower back discomfort  
56% of subjects reported knee discomfort

Other areas mentioned:

- Glutes: 6
- Hips: 6
- Arms: 6
- Quads: 5
- Head (striking ceiling): 4





# Question 4. Which MEDEVAC features impacted trial completion?

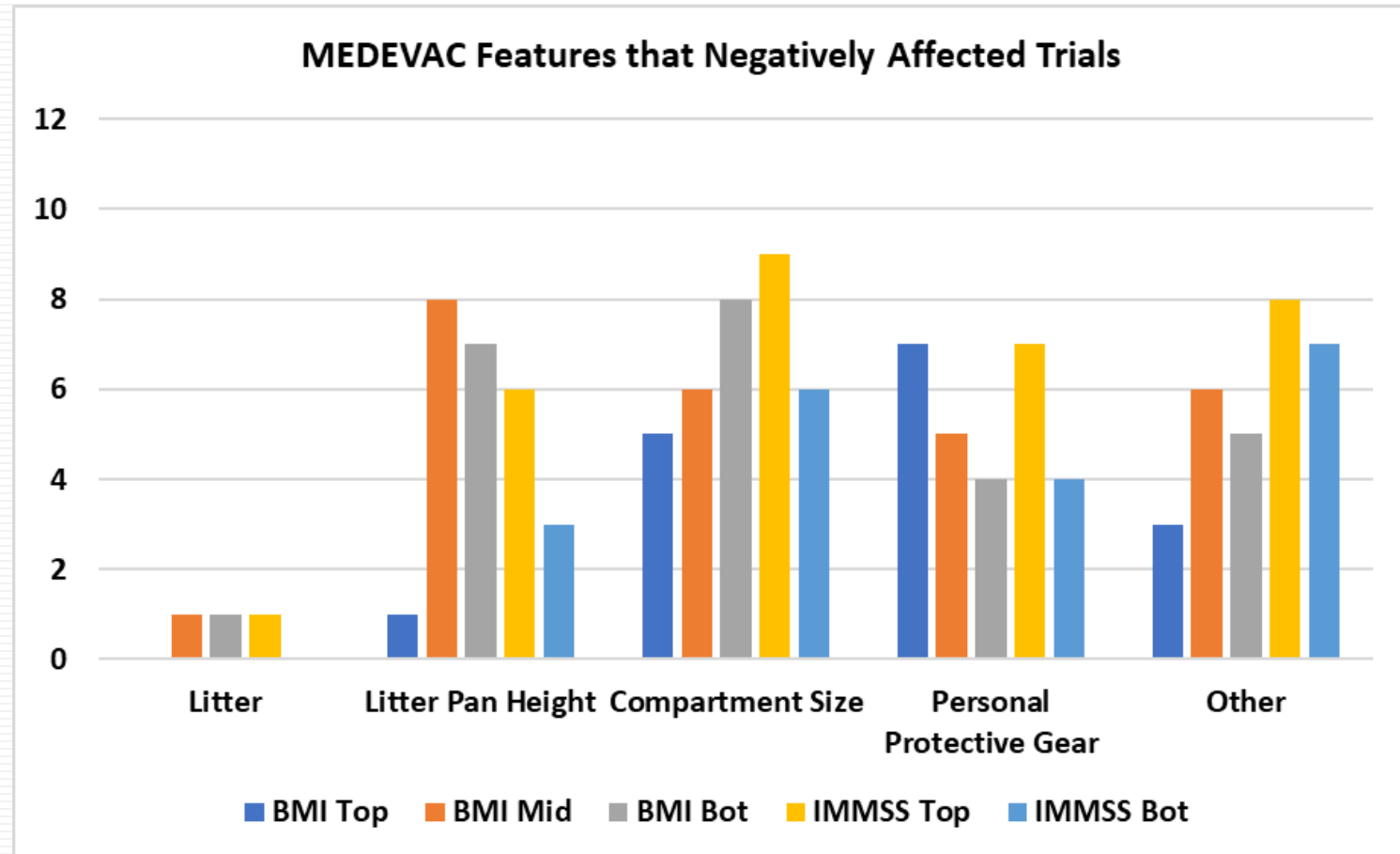
71% of subjects reported the litter pan height affected the trial

71% of subjects reported the personal protective gear affected the trial

65% of subjects reported the compartment size affected the trial

Other MEDEVAC features mentioned:

- Bumping Litter Pans: 16
- Catching Stirrup Indents: 4
- Hitting helmet on ceiling: 3





En route care providers are reporting injuries from the painful postures resulting from loading and unloading patients in the MEDEVAC environment.

- All subjects mentioned at least one posture and one area of the body negatively affected

## MIL-STD-1427 – Department of Defense Design Criteria Standards

Whole Body Movement: When large forces (more than 13.6 kilograms (kg) [30 lb]) or large control displacements (more than 380 millimeters [mm] [15 inches (in.) in a fore-aft direction] are required, the user shall have enough space to move their entire body

- The height of the MEDEVAC interior is 54.25 in., and the average subject height was 71.38 in.



The results from this study agree with the qualitative anonymous survey USAARL provided to enroute care providers:

- 87% ( $n = 60$ ) suffering lower back injuries → 77% ( $n = 17$ ) of subjects reported lower back discomfort
- 60% ( $n = 60$ ) reported MEDEVAC features affected patient handling → 94% ( $n = 17$ ) reported at least one MEDEVAC feature affecting the trial

These findings will contribute to the development of future MEDEVAC medical interiors and prevent injuries to the en route care providers during patient loading and unloading procedures

NOTE: The forthcoming technical report will contain more motion data analysis, and address possible design improvements or loading techniques to limit awkward postures



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# Questions?



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