

#### The webcast will begin shortly...

## Physical Stresses on Caregivers when Repositioning Patients in Bed

December 10<sup>th</sup> , 2020





# Outline

- General introduction to the AnyBody Modeling System
- Presentation by Jie Zhou
  - Physical Stresses on Caregivers when Repositioning Patients in Be
- Question and answer session



**Presenter**: Jie Zhou, Ph.D, AEP Ergonomics researcher in Hillrom



#### Host:

Kristoffer Iversen R&D Engineer AnyBody Technology



# Control Panel

The Control Panel appears on the right side of your screen.

Submit questions and comments via the Questions panel.

Questions will be addressed at the end of the presentation. If your question is not addressed, we will do so by email.





## **Musculoskeletal Simulation**

Motion Data Kinematics and Forces







#### **Body Loads**

- Joint moments
- Muscle forces
- Joint reaction forces

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#### December 1<sup>st</sup>, 2020





Product optimization design

**ANYBODY** Modeling System



ANY BODY

Sports





Orthopedics and rehab



# AnyBody Modelling System



### Physical Stresses on Caregivers when Repositioning Patients in Bed

Presented by Jie Zhou



## Physical Stresses on Caregivers when Repositioning Patients in Bed

– JIE ZHOU, PHD, AEP



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- Caregivers are more vulnerable to musculoskeletal disorders (MSDs) than most other occupations<sup>1</sup>
- Repositioning patients in bed is most common patient handling activity<sup>2</sup>
- Manual repositioning is associated with risk of MSDs <sup>3,4</sup>



1. BLS, 2016. Nonfatal occupational injuries and illnesses requiring days away from work, 2015. Bureau of Labor Statistics.

2. Poole Wilson, T., Davis, K. G., Kotowski, S. E., & Daraiseh, N. (2015). Quantification of patient and equipment handling for nurses through direct observation and subjective perceptions. Advances in Nursing, 2015.

3. Marras, W. S., Davis, K. G., Kirking, B. C., & Bertsche, P. K. (1999). A comprehensive analysis of low-back disorder risk and spinal loading during the transferring and repositioning of patients using different techniques. Ergonomics, 42(7), 904-926.

4. Fragala, G. (2011). Facilitating repositioning in bed. AAOHN Journal, 59(2), 63-



- Manual repositioning aids compared to mechanical lifts
  - o Cheaper initial investment
  - May be more readily available
  - $\circ\,$  Perceived to take less time to use





- Most previous studies:
  - $\circ$  Investigated only one type of repositioning aid <sup>5</sup>.
  - Tested only a single patient weight<sup>6</sup>.
  - Did not perform biomechanical analysis or estimate risk of injury
- The objective: investigate the risk of injury on caregivers when repositioning patients in bed for several combinations of 1) repositioning activity, 2) patient weight and 3) repositioning aid

5. Fray, M., David, D., Hindson, D., Pattison, L. and Metcalfe, D., 2016. Does the use of friction reducing devices actually reduce the exposure to high force lateral transfers?. The Healthcare Systems Ergonomics and Patient Safety Conference (HEPS 2016).

6. Skotte, J., & Fallentin, N. (2008). Low back injury risk during repositioning of patients in bed: The influence of handling technique, patient weight and disability. Ergonomics, 51(7), 1042–1052.



- Participants:
  - $\circ$  Caregivers
    - N=10
    - Height: 169.8 cm (7.6 cm), weight: 80.4 kg (16.6 kg)
    - Experience: 7.5 years (SD 3.7 years).
  - Simulated Patients
    - N=3
    - Weight: 50, 77, 141 kg



- Repositioning aids:
  - Air-assisted repositioning devices (AARD)
  - o Friction reducing sheets (FRS)
  - Turn and position systems (TAP)



Non-stretchable traditional cotton draw sheet (DS)





#### FRS



- Equipment
  - Motion capture system
  - Force platform
  - Force gauges
- AnyBody Modeling System<sup>® 7,8</sup>



7. Bassani, T., Stucovitz, E., Qian, Z., Briguglio, M., & Galbusera, F. (2017). Validation of the AnyBody full body musculoskeletal model in computing lumbar spine loads at L4L5 level. Journal of Biomechanics, 58, 89-96.

8. Damsgaard, M., Rasmussen, J., Christensen, S. T., Surma, E., & De Zee, M. (2006). Analysis of musculoskeletal systems in the AnyBody Modeling System. Simulation Modelling Practice and Theory, 14(8), 1100-1111.



- Repositioning Activities
   Studied
  - o Pull up in Bed
  - Lateral Repositioning
  - o Lateral Transfer







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- Procedure
  - Two repetitions, 90
     total trials per subject
  - Order of test
     conditions was
     partially randomized
  - Bed height was set
     by the caregiver









- Independent variables
  - Repositioning aids
    - DS, TAP, FRS, AARD
  - o Patient weight
    - 50, 77, 141 kg
- Dependent variables
  - Peak L5/S1 compression
    - Compared to 3400 N limit <sup>9</sup>
  - Peak pulling force
    - Compared to 245 N limit <sup>10</sup>







9. Waters, T.R., Putz-Anderson, V., Garg, A. and Fine, L.J., 1993. Revised NIOSH equation for the design and evaluation of manual lifting tasks. Ergonomics, 36(7), pp.749-776.

10. Snook, S. H., & Ciriello, V. M. (1991). The design of manual handling tasks: revised tables of maximum acceptable weights and forces. Ergonomics, 34(9), 1197-1213. 10

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METHODS

- AnyBody Modeling System®
  - Pulling force, ground
     reaction force, markers
     coordinates
  - o Anthropometry
  - o Kinematics
  - o Inverse dynamics











### **I**•I<sup>•</sup> Hillrom<sub>™</sub>



- Statistical analysis
  - Repeated measures ANOVA
  - Tukey-Kramer post-hoc tests
  - o Participant was set as a random factor
  - $\circ$  Significance criteria  $\alpha$  < 0.05

## Pull up in bed-Peak L5/S1 compression (N)





## Pull up in bed-Peak pulling force (N)

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## Pull up in bed-Spine Compression vs. Pulling Force



**DS TAP FRS ARD DS**-Not tested

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## Lateral repositioning-Spine Compression vs. Pulling Force



## Lateral Transfer-Spine Compression vs. Pulling Force

Peak L5/S1 compression (N)

Peak pulling force (N)



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### Recommendation

		Patient Weight (kg)										
Activity	Condition	50*	60	70	77* 80	90	100	110	120	130	141*	
Boosting	Draw sheet											
	TAP											
	FRS											
	AARD											
Lateral Reposition	Draw sheet											
	TAP											
	FRS											
	AARD											
Lateral Transfer	Draw sheet											
	FRS											
	AARD											

### Implications

- Draw sheet is unacceptable to perform manually for any size patient
- Friction Reducing Sheets is only acceptable for lighter patients
- Only Air Assisted Repositioning Devices (AARD) resulted in forces below the injury thresholds for all tested conditions
- However, AARD needs to be placed and removed before and after use; Inflated, disinfected;
- Mechanical lifts with repositioning sheet remain the lowest risk, repositioning sheet can be left under the patient.



### AARD compared to mechanical lift





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### Limitations

- Installing and removing repositioning aids was not evaluated
- Joint forces on other affected regions were not evaluated
- Only one model of each type of repositioning aid was assessed



- For patient repositioning, pulling force appears to drive injuries more than spine compression
- Repositioning aids reduce physical stress on caregivers. However, most aids are only appropriate for lighter patients<sup>11</sup>
- Air Assisted Repositioning Devices can be used to safely reposition most patients, but usability concerns may be a barrier for caregivers to use
- A mechanical lift and repositioning sheet are most ideal <sup>12</sup>

11. Lafleur, B., Weaver, T., Tondat, A., Boscart, V., & Laing, A. C. (2018). Manual Patient Transfers–Factors That Influence Decisions and Kinematic Strategies Employed by Nursing Aides. Ergonomics, (just-accepted), 1-12.

12. American Nurses Association, 2013. Safe patient handling and mobility: Interprofessional national standards. Silver Spring, MD: Nursesbooks.org.

### Acknowledgement

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## Thanks, and questions



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- 1. BLS, 2016. Nonfatal occupational injuries and illnesses requiring days away from work, 2015. Bureau of Labor Statistics.
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- 3. Waters, T. R., Nelson, A., & Proctor, C. (2007). Patient handling tasks with high risk for musculoskeletal disorders in critical care. Critical care nursing clinics of North America, 19(2), 131-143.
- 4. Fragala, G. (2011). Facilitating repositioning in bed. AAOHN Journal, 59(2), 63-68.
- 5. Fray, M., David, D., Hindson, D., Pattison, L. and Metcalfe, D., 2016. Does the use of friction reducing devices actually reduce the exposure to high force lateral transfers?. The Healthcare Systems Ergonomics and Patient Safety Conference (HEPS 2016).
- 6. Skotte, J., & Fallentin, N. (2008). Low back injury risk during repositioning of patients in bed: The influence of handling technique, patient weight and disability. Ergonomics, 51(7), 1042–1052.
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- 8. Damsgaard, M., Rasmussen, J., Christensen, S. T., Surma, E., & De Zee, M. (2006). Analysis of musculoskeletal systems in the AnyBody Modeling System. Simulation Modelling Practice and Theory, 14(8), 1100-1111.
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- 10. Snook, S. H., & Ciriello, V. M. (1991). The design of manual handling tasks: revised tables of maximum acceptable weights and forces. Ergonomics, 34(9), 1197-1213.
- 11. Baptiste, A., Boda, S.V., Nelson, A.L., Lloyd, J.D. and Lee III, W.E., 2006. Friction-reducing devices for lateral patient transfers: a clinical evaluation. Aaohn Journal, 54(4), pp.173-180.
- 12. Theou, O., Soon, Z., Filek, S., Brims, M., Leach-MacLeod, K., Binsted, G. and Jakobi, J., 2011. Changing the sheets: a new system to reduce strain during patient repositioning. Nursing research, 60(5), pp.302-308.

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#### **Upcoming Webcasts**

 January 12<sup>th</sup> - Biomechanical investigation of a passive upper extremity exoskeleton for manual material handling – A computational parameter study.

#### Meet us? Send email to <u>sales@anybodytech.com</u>





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#### 10 Dec: Physical stresses on caregivers when repositioning patients in bed

Repositioning patients in bed is the most common patient handling activity and is associated with musculoskeletal disorders in caregivers. Repositioning aids may mitigate the risk of injury. The current study investigated the effects of commonly used repositioning aids on the physical stress on caregivers.

Your presenter is Jie Zhou, Ergonomics researcher at Hillrom; Ph.D, AEP. Jie's presentation will be made twice:

Sign up for 1st presentation 10 December at 16:00 CET Sign up for 2nd presentation 10 December at 21:00 CET



#### 12 Jan: Biomechanical investigation of a passive upper extremity exoskeleton for manual material handling - A computational parameter study

Manual material handling tasks at supermarket stores is a very common activity and it is associated with the development of work-related musculoskeletal disorders. This presentation will show how on-site data recordings can be used together with the AnyBody Modeling System to assess the benefits of a passive upper extremity exoskeleton as a protective device. Additionally, it will provide an interesting computational parameter approach to investigate how to adjust an exoskeleton to fit a specific task.

Presented twice by Bo E. Seiferheld, M.Sc. Sports Technology, Department of Health Science and Technology, Aalborg University, Denmark:

Sign up for 1st presentation 12 January at 9:00 CET Sign up for 2nd presentation 12 January at 17:00 CET





Ergonomics







# Time for questions:



December 1<sup>st</sup>, 2020