



Ergonomic evaluation of hospital bed design features during patient handling tasks

Ranjana K. Mehta, Leanna M. Horton, Michael J. Agnew, Maury A. Nussbaum*

Department of Industrial and Systems Engineering, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA 24061, USA

ARTICLE INFO

Article history:

Received 21 July 2010

Received in revised form

13 June 2011

Accepted 11 July 2011

Available online 9 August 2011

Keywords:

Hospital bed

Physical demands

Healthcare workers

ABSTRACT

Patient handling tasks (e.g., transportation and repositioning) are important causes of musculoskeletal disorders among healthcare workers. The purpose of this study was to evaluate, during two patient handling tasks, the physical demands resulting from alternative hospital bed design features. Twenty-four novice participants were involved in two laboratory-based studies. The effects of a steering lock and adjustable push height were evaluated during a patient transportation task using perceptual responses and measures of performance and physical demands, and the effect of a bed contour feature was determined based on patient sliding distance during repeated bed raising/lowering. Use of the steering lock reduced the number of adjustments during bed maneuvering by 28% and decreased ratings of physical demands. Use of the adjustable push height reduced shoulder moments by 30%. With the contour feature, patient sliding distance was reduced by ~40% over 12 raise/lower cycles. These results suggest that the steering lock and adjustable push height features can reduce physical demands placed on healthcare workers during patient transportation tasks. Although patient sliding distance was reduced using the contour feature, assessing direct effects of this feature on physical demands (e.g., reduced need for workers to reposition patients) will require further investigation.

Relevance to industry: Hospital bed design features have the potential to reduce physical demands required of healthcare workers, yet there have been only limited empirical studies of these. Findings of the two current studies suggest that proactive ergonomic considerations in hospital bed design can reduce these physical demands.

© 2011 Elsevier B.V. All rights reserved.

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are prevalent among healthcare workers. Recent data indicate that nursing aides, orderlies, and attendants in the U.S. experienced injuries or illnesses requiring days away from work at a rate of 455/10,000 workers, approximately 4 times higher than the national average across all occupations, and resulting in a total of 50,620 days away from work (BLS, 2010). Among nurses and nursing aides, there is a particularly high prevalence of back pain and a high rate of workers' compensation claims for back injuries (Waters et al., 2006; Zhuang et al., 1999). Thus, there is a need to further identify and control exposures that ultimately lead to such outcomes.

Existing evidence suggests that several manual patient handling tasks (e.g., positioning patients on a bed, transferring patients between a bed and chair, repositioning patients in bed) lead to high physical demands (Petzall et al., 2001) and are strongly associated

with the development of low back disorders and pain (ANA, 2009; Engkvist, 2008; Marras et al., 1999; Smedley et al., 1995; Yip, 2001). Training and/or assistive devices are common approaches used to control the risk of WMSDs associated with performing such tasks. Training on manual patient handling techniques can reduce low back loads during patient handling (Garg and Owen, 1994; Hodder et al., 2010; Winkelmolen et al., 1994); however, even with training it has been suggested that high physical demands remain (Marras et al., 1999). Assistive devices, such as lift and transfer aids, can decrease physical demands during patient handling, particularly in the low back (Keir and MacDonell, 2004; Marras et al., 1999; McGill and Kavcic, 2005; Zhuang et al., 1999). However, such devices alone may not reduce demands enough to ensure worker safety (Nelson and Baptiste, 2006; Waters et al., 2007). Furthermore, unavailability of these devices, lack of proper training in the use of mechanical aids, and nurses' perceptions of increased time and difficulty in using mechanical aids, have hindered the effectiveness of assistive devices in reducing physical demands (Nelson and Baptiste, 2006).

An increased emphasis has been placed on developing medical device designs that can accommodate the needs of both patients

* Corresponding author. Tel.: +1 540 231 6053; fax: +1 540 231 3322.

E-mail address: nussbaum@vt.edu (M.A. Nussbaum).