

References

1. Agency for Healthcare Research and Quality, Rockville, MD. Preventing Falls in Hospitals. Content last reviewed July 2018. <https://www.ahrq.gov/professionals/systems/hospital/fallpxtoolkit/index.html>
2. Collins, J., Nelson, A., Sublet, V. (2006). Safe lifting and movement of nursing home residents.DHHS (NIOSH) Publication Number 2006-117.
3. Karahan A, Kav S, Abbasoglu A, Dogan, N., (2009). Low back pain: prevalence and associated risk factors among hospital staff. J Adv Nurs, 65, 516-24.
4. Pompeii, L., Lipscomb, H., Schoenfisch, A., Dement, J. (2009). Musculoskeletal injuries resulting from patient handling tasks among hospital workers. American Journal of Industrial Medicine, 52(7), 571-8.
5. Trinkoff A.M., Lipscomb J.A., Geiger-Brown J, Brady B. (2002). Musculoskeletal problems of the neck, shoulder, and back and functional consequences in nurses. Am J Ind Med, 41(3), 170-178.
6. Weil, T,(2015), Patient falls in hospitals: An increasing problem ,Geriatric nursing (New York, N.Y.) 36(5)DOI: 10.1016/j.gerinurse.2015.07.004SourcePubMed
7. Oliver, D, Healey, F, and Haines, T, (2010), Preventing Falls and Fall-Related Injuries in Hospitals, Clinics in Geriatric Medicine, 26: 645-692
8. Hitcho, EB, Krauss, MJ, Birge, S, Dunagan, WC, Fischer, I, Johnson, S, et al., (2004), “Characteristics and circumstances of falls in a hospital setting: A prospective analysis,” Journal of General Internal Medicine, vol. 19, pp. 732-739
9. Hester, AL, (2015) Preventing injuries from patient falls Learn tips for averting injuries after a fall, American Nurse Today, (10)7, 36-37
10. Morse JM, Gervais P, Pooler C, Merryweather A, Doig AK, Boswicz D, (2015), The Safety of Hospital Beds: Ingress, Egress, and In-Bed Mobility, Global Qualitative Nursing Research, Volume 2, April 2015. <https://journals.sagepub.com/doi/10.1177/2333393615575321>
11. Tzeng H.M., Prakash A., Brehob M., Anderson A., Devecsery D.A., Yin C.Y. (2013), How feasible was a bed-height alert system? Clin. Nurs. Res. 22:300–309.
12. Growdon, ME, Shorr,RI, Inouye, SK, (2017). The Tension Between Promoting Mobility and Preventing Falls in the Hospital, JAMA Intern Med. 177(6) :759-760
13. Tipping CJ, Harrold M, Holland A, Romero L, Nisbet T, Hodgson CL. (2017), The effects of active mobilisation and rehabilitation in ICU on mortality and function: a systematic review. Intensive Care Med. 43:171–83
14. Hamilton, AC, Lee, N, Stilphen, M, Hu, B, Schramm, S, Frost, F, Fox, J, Rothberg, MB, (2019), Increasing Mobility via In-hospital Ambulation Protocol Delivered by Mobility Technicians: A Pilot Randomized Controlled Trial. J. Hosp. Med, 5;272-277. Published online first February 20, 2019. doi:10.12788/jhm.3153
15. Health Research & Educational Trust (June 2018). Falls with Injury Change Package: 2018 Update. Chicago, IL: Health Research & Educational Trust. Accessed at <http://www.hret-hiin.org/>
16. US Bureau of Labor Statistics (2017). Occupational injuries and illnesses among registered nurses. Retrieved from: <https://www.bls.gov/opub/mlr/2018/article/occupational-injuries-and-illnesses-among-registered-nurses.htm>
17. Bowers, B, Lloyd, J, Lee, W, Powell-Cope, G, Baptiste, A, (2008), Biomechanical Evaluation of Injury Severity Associated with Patient Falls from Bed, Rehabilitation Nursing 33(6):253-259.
18. Nitz J, Cyarto E, Andrews S, Fearn M, Fu S, Haines T, Haralambous B, Hill K, Hunt S, Lea E, Moore K, Renehan E, Robinson A. (2011), Outcomes from the implementation of a facility-specific evidence based falls prevention intervention program in residential aged care. Geriatric Nursing. 33(1): 41–50.
19. Hunderfund AN, Sweeney CM, Mandrekar JN, et al. (2011) Effect of a multidisciplinary fall risk assessment on falls among neurology inpatients. Mayo Clin Proc.; 86(1):19-24.
20. Kolin MM, Minnier T, Hale KM, et al. (2010). Fall initiatives: redesigning best practice. J Nurs Adm; 40(9):384-391
21. Quigley PA, Hahn B, Collazo S, et al. (2009). Reducing serious injury from falls in two veterans’ hospital medical-surgical units. J Nurs Care Qual.; 24(1):33-41.
22. Hartford Institute for Geriatric Nursing. (2008), Preventing falls in acute care. In: Capezuti, E.; Zwicker, D.; Mezey, M.; Fulmer, T., editors. Evidence-based geriatric nursing protocols for best practice. 3rd ed. New York: Springer; p. 161-198.
23. Hughes MA, Schenkman ML, (1996), Chair rise strategy in the functionally impaired elderly. J Rehabil Res Dev. 33(4):409-12.
24. Weiner DK, Long R, Hughes MA, et al. (1993), When older adults face the chair-rise challenge: a study of chair height availability and height-modified chair-rise performance in the elderly. J Am Geriatr Soc. 41:6–10.
25. Tzeng, H. M., Prakash, A., Brehob, M., Devecsery, D. A., Anderson, A., & Yin, C. Y. (2012). Keeping patient beds in a low position: an exploratory descriptive study to continuously monitor the height of patient beds in an adult acute surgical inpatient care setting. Contemporary nurse, 41(2), 184–189. doi:10.5172/conu.2012.41.2.184
26. Tzeng, HM, Yin, C, (2008), Nurses’ solutions to prevent inpatient falls in hospital patient rooms,” Nursing Economics, 26: 179-187.
27. Alexander NB, Grunawalt JC, Carlos S, Augustine J, (2000) Bed mobility task performance in older adults. Journal of Rehabilitation and Research Development. 37(5):633-8.
28. Roubenoff R, Wilson PW. (1993), Advantage of knee height over height as an index of stature in expression of body composition in adults. The American Journal of Clinical Nutrition. 57(5):609–613.
29. Christman, M, Morse, J, Wilson, C, Godfrey, N, Alexa Doig, A, Boswicz, D, Merryweather, A,(2015) Analysis of the influence of hospital bed height on kinematic parameters associated with patient falls during egress, 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015, Procedia Manufacturing 3, 280 – 287
30. Den Ouden ME, Schuurmans MJ, Arts IE, van der Schouw, YT.(2015), Physical performance characteristics related to disability in older persons: a systematic review. Maturitas. 69(3):208-19.
31. Fray, MJ, Hignett, S, (2015), An evaluation of the biomechanical risks for a range of methods to raise a patient from supine lying to sitting in a hospital bed. 19th Triennial Congress of the International Ergonomics Association, Melbourne, Australia, 9th-14th August 2015.
32. Kong, Y. & Lowe, B. (2005). Optimal cylindrical handle diameter for grip force tasks. International Journal of Industrial Ergonomics, 35(1), 495-507



Design powered by research

Improving patient and caregiver safety through evidence-based design

By Guy Fragala, Ph.D., PE, CSP, CSPHP

When hospitals design and implement changes into their environment of care, there is an opportunity to address and solve some of the current clinical problems they face. Bed frames – which can be a solution to these challenges – are a critical element within the environment of care, and warrant careful consideration to ensure optimum selection is achieved for each individual patient.

It is the opinion of the author, if hospitals gain a better understanding of the risk factors related to patient falls and staff injuries – and acquire beds which better consider the needs of the patient – significant progress can be achieved in improving patient and caregiver safety in the environment of care.

In this white paper, three key facets of care are explored that should be considered when selecting a bed frame for your patient population: **fall and injury prevention, optimized clinical workflows and patient mobility** in conjunction with caregiver ergonomics.

Finding solutions

Having the appropriate capabilities and features on hospital beds is important for both patient and caregiver safety, but ensuring these features are being used correctly and effectively is essential. Integrating proper design features into bed frames can be a very important factor to encourage patient mobilization and minimize risk factors related to patient falls. It is the opinion of the author that when choosing a bed system for a hospital, there are many features to consider.

Patient falls and injury

>85

Most falls occur in the patient’s room (50-85%) on or near the bed while unassisted (79%)⁷⁻⁸

Considering causation

Around the world, hospitals invest a considerable amount of effort into preventing patient falls during hospitalization. Yet despite six decades of worldwide efforts, there has been an increase in the number of patient falls in hospitals and other healthcare facilities (estimated to be 46% per 1000 patient days from 1954-6 to 2006-10).⁶ Each year, between 700,000 and 1,000,000 people in the United States fall in the hospital. In order to seek improvement related to the risk for falls, it is important to gain an understanding of where and how these falls are happening¹. **Most falls occur in the patient’s room (50-85%) on or near the bed while unassisted (79%)⁷⁻⁸**. However, research shows that at least one-third of falls can be prevented¹.

While fall prevention has become standard in inpatient care, injury prevention has gotten less attention, both in research and everyday practice. Injuries from falls can have serious consequences in patients, ranging from minor cuts and bruises to fractures, head injuries and even death⁹. **Approximately one third of falls lead to patient harm with 4-6% of those resulting in serious injury⁸**. Patients who suffer injurious falls have an increased hospital stay and greater discharge rate to long term care facilities¹⁰.

Most falls do not have a single cause, but result from the interaction of several intrinsic and extrinsic risk factors. Impaired cognitive function, medications and impaired mobility along with the patient environment can increase risk for falls from the bed, as it may impair ability to rise and move independently¹¹. Prevention is a comprehensive approach and involves managing a patient’s underlying fall risk factors and optimizing the hospital’s physical design and environment¹. Additionally, monitoring of patients can be labor intensive and difficult to implement with limitations of available staff.

1/3

Approximately one third of falls lead to patient harm with 4-6% of those resulting in serious injury⁸

Advanced fall prevention

Low bed height for injury prevention

For those patients who are at risk of falling out of bed, seeking a bed frame which provides the lowest possible low height setting is important for injury prevention. Bed height has been identified as one of the extrinsic contributory factors of falls in adult inpatient care settings¹¹. Research conducted at the Patient Safety Center in Tampa, Florida demonstrated low bed height is tied to better patient outcomes should a patient roll out of bed. **This is because impact forces are reduced as fall height is reduced, translating to a reduced risk of serious injury^{9,17}**. Additionally, Morse and authors conducted research on the biomechanics of patient egress and the authors’ findings determined fall risk may be reduced in a high-risk population by setting a bed deck height that compliments the balance strategies commonly used to compensate for deficits in strength and mobility¹⁰. As such, a low bed position has been shown to be an effective measure for hospital falls management programs by reducing th incidence of falls and related injuries, but should not be considered the standard bed position for all patient heights^{9, 18-22}. Furthermore, the ability to achieve a very low position has been shown to be an effective measure for hospital falls management programs, demonstrating a reduced incidence of falls and related injuries.^{9,18-22}

Workflow efficiencies

- Providing near real-time information to caregivers
- Bed monitoring systems – ensures compliance around bed configuration
- Wireless technology provides a proactive approach helping to prevent falls



Workflow efficiencies and technology

Alarming devices (such as bed exit alarm systems) can be a key safety intervention for patients who are prone to falls. To ensure the effectiveness of this strategy, proper implementation and education is necessary for all parties involved, as is ongoing oversight surrounding the use of the devices³². The concept of bed exit alarm systems does make sense and is an intervention strategy that should not be dismissed as ineffective, but rather re-visited as part of a comprehensive monitoring system. Monitoring of patients can be labor intensive and difficult to implement with staff limitations. With current available wireless technology capabilities that can be integrated into bed systems, more comprehensive smart monitoring systems can be developed beyond what has been done to date with bed exit alarms.

Beyond the concept of alarms when a patient is exiting the bed, monitoring might also include alerts for other indicators related to the bed, such as bed height or side rail configuration, which could put the patient at a higher risk for a fall. A study examining the feasibility of a bed-height alert system found that this type of system could potentially promote patient safety and prevent bed-related injurious falls¹³.

Preliminary evidence also suggests that a technological solution using wireless communication and smart bed technology may enhance the benefits of low bed height and help mitigate the long-standing patient safety issue of patient falls in acute care hospitals. Furthermore, this technology can provide hospitals with baseline information for quality improvement purposes, such as response time from alarm to assist. Although further research is necessary to continue to assess the effectiveness of such systems in hospital settings³³, there should be continued commitment to the development of the capabilities of smart bed technology and wireless bed communication systems. Integrating wireless bed communication, bed data, and bed exit alarm systems offers hospitals additional opportunities for improved fall prevention programs and compliance to best practices in prevention.



Patient mobility and caregiver ergonomics

Growing importance of mobility

It has been known for years that patient immobility while hospitalized contributes to undesirable outcomes, such as increased rates of functional decline and institutionalization¹². As research increasingly supports the critical need for mobilizing hospitalized patients, the demand on caregivers to assist patients with movement and mobility also increases¹³. As is typical to the hospital setting, patients often depend on their caregivers for mobility needs, and the physical demands consequently place risk on both the patient and caregiver.

The paradox between promoting mobility and preventing Falls

Despite widespread implementation of hospital fall prevention efforts over the past 20 years, evidence shows the rate of “injurious falls” has not declined significantly in the United States. The problem with some current fall prevention efforts may lie in the troubling assumption that keeping patients from moving can stop such falls from occurring. When older adults are hospitalized, there is an inherent tension between preventing falls and promoting mobility. In response to public and professional attention to medical errors, federal policy and hospital culture has strongly prioritized preventing falls, with potential unintended consequences related to patient mobility, functional mobility, and well-being¹².

Therefore, early and frequent mobilization should be viewed as an effective means to enhancing fall prevention, and organizations should consider transforming fall prevention teams into mobility teams to improve patient outcomes^{12,14}. In a recent comprehensive analysis and report on best practices for fall prevention, adoption of an organization-wide commitment to safe mobilization was identified as essential in achieving sustainable results in fall injury prevention¹⁵.

45.6%

Overexertion and bodily reaction were the most prevalent events leading to occupational injuries and illnesses to registered nurses, accounting for 45.6% of all cases within the occupation in 2016¹⁶

Caregivers at risk for injury

Currently much attention is being focused on the occupational hazards of healthcare workers. Reviewing injury incidence rates available from the Bureau for Labor Statistics, healthcare workers are consistently listed as one of the groups at highest risk for occupational musculoskeletal disorders. Overexertion and bodily reaction were the most prevalent events leading to occupational injuries and illnesses to registered nurses, accounting for 45.6% of all cases within the occupation in 2016. By far, the leading source of injury was identified as the patient, which highlights the fact that nurses are frequently injuring themselves when helping patients with movement and mobility¹⁶. Practitioner evidence from multiple locations indicates that many patients are being assisted from supine lying to sitting up using manual techniques, which is placing caregivers at risk of injury.

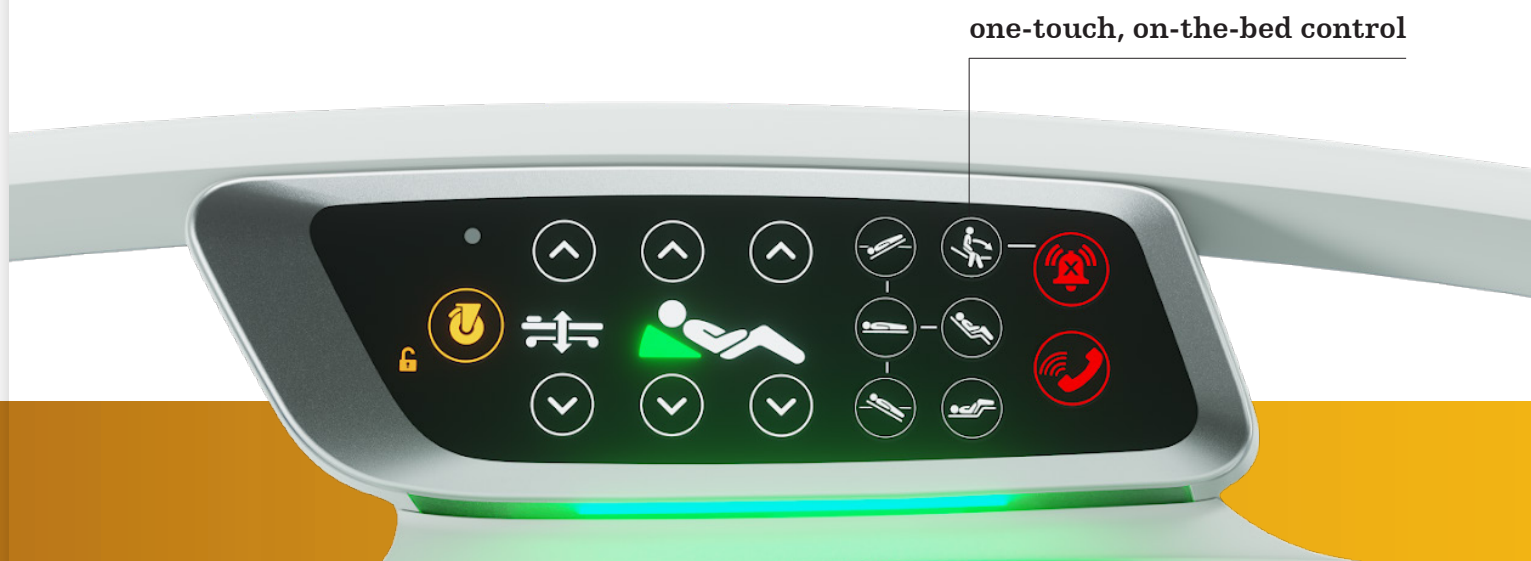


Patient mobility and caregiver injury

Bed height and patient mobility

In an effort to encourage mobility and minimize fall risk, it is important for a bed frame to easily achieve the proper height for the facilitation of patient egress. Studies conducted on the sit to stand motion have indicated that the optimum seat height to facilitate the standing process is slightly above knee height with feet placed flat and firmly on the floor²³⁻²⁴. Additional studies have provided recommendations specific to optimum heights for hospital bed surfaces to facilitate standing. These recommendations indicate that the height of the hospital bed, from the floor to the top of the bed surface in the horizontal position, should be adjustable to at or slightly above knee height for the entire range of the patient population, with an **average target height of 21.3 inches for men and 19.49 inches for women**²⁵⁻²⁸.

The ability to achieve this height easily through a one-touch, on-the-bed control benefits both independent patients and those who require assistance when exiting the bed. When the bed surface is at the correct height, it is easier for patients to stand and allows the caregiver to provide assistance as needed.



Side rails - patient mobility and caregiver injury

Bed side rail design, with accessible grab points, which can facilitate safe bed egress for both the patient and the caregiver. Providing well-designed siderails allows patients to use their hands and arms in the process of standing will further facilitate the standing task, improving safety, increasing independence and contributing to dignity.



Further consideration of proper upper limb motion strategies and proper upper limb positioning during the rise, particularly when considering the deficits of the person, may present a realistic and viable strategy to enhance mobility practices, while protecting caregivers.



Height adjustability

Bed surface height is very important when considering the safety of the patient and caregiver. Factors important to consider when determining desired bed surface heights include:

- What is the best surface height to reduce potential injury risk severity if a fall from bed should occur?
- What is the best surface height to facilitate bed egress?
- What is the best bed surfaces height to reduce physical demands on the caregiver?

There is no one single bed surface height which is optimum for the activities mentioned above and for other activities which may occur in a hospital due to variance in the patient population. Therefore, the best option is to select beds with a wide height adjustability, where the most desirable heights are easily achieved. For example:

- Low position for patient safety
- Reliable position for patient ingress/egress
- High position for caregiver safety with manual handling
- One touch control presets for these types of specific important height settings



Seeking improvements through proper bed selection



Integrating proper design features into bed frames can be a very important factor to encourage patient mobilization and minimize risk factors related to patient falls. When selecting beds for the care environment, some important considerations related to facilitating mobilization and preventing falls are as follows:

- A bed exit alarm system which employs the latest sensor technology and can be customized per a patient’s fall risk identified during assessment.
- Ability to achieve a very low position, which can reduce the potential severity of injury if a patient were to roll out of bed.
- Technological solutions using wireless communication and smart bed technology to help enhance the benefits of monitoring bed status that can be integrated with the bed exit alarm system, nurse call and other communication systems in the hospital.
- Ability to easily achieve optimum bed egress height and position for each individual patient.
- One touch, on-the-bed control that automatically positions the bed at the optimum egress height for the general patient population, with the ability to make minor adjustments as needed to accommodate smaller and larger patients.
- Bed siderail design, with accessible grab points to facilitate mobility and safe bed egress for both the patient and the caregiver.



Guy Fragala

Ph.D., PE, CSP, CSPHP

Dr. Fragala has over 45 years of experience as a healthcare professional and is recognized as one of the pioneers of Safe Patient Handling and Mobility efforts in the United States. He has lectured throughout the world and is a recognized international expert in the application of ergonomics to the healthcare setting. Currently he helps and supports a number of organizations, vendors and facilities with their safe patient handling and mobility efforts. In 2012 he was awarded the National Advocacy Award for Improved Caregiver Safety and in 2017 awarded the Bernice Owen Safe Patient Handling and Mobility Research Award. His book entitled, *Ergonomics: How to Contain On-the-Job Injuries in Healthcare*, published by the Joint Commission on Accreditation of Healthcare Organizations, has influenced much of the work today related to healthcare ergonomics and safe patient handling and mobility programs.