INSTITUTE FOR QUALITY, SAFETY & INJURY PREVENTION

ENA Topic Brief

Avoiding the Log Roll Maneuver: Alternative Methods for Safe Patient Handling

Key Information

- Trauma patients with suspected spinal injuries may need to be moved several times between leaving the scene of the traumatic event and receiving definitive surgical stabilization.
- The log roll maneuver has been demonstrated to increase spinal movement compared with alternative methods.
- Log-rolling during the initial survey is now considered undesirable for all blunt trauma patients except those lying prone.[12]
- Alternatives to the log roll include the straddle lift, the 6-plus lift-and-slide, or the use of various assistive devices.
- Poor body mechanics involved in log-rolling a patient can contribute to musculoskeletal injuries to healthcare workers.[24]
- Current research and recommendations are shifting to safer alternatives to the log roll maneuver.
- Overall cumulative motion to the unstable spine can be reduced by approximately 50% if the log roll is avoided and alternative measures are employed.[4]

Purpose

Trauma patients with suspected spinal injuries may need to be moved several times between leaving the scene of the traumatic event and receiving definitive surgical stabilization.[1–5] Each transfer may cause or exacerbate a neurologic injury in patients with an already unstable spine. To reduce the risk of secondary neurologic injury, effective transfer techniques need to be established for the transport and care of these patients. The log-rolling maneuver has long been a mainstay in the assessment and transfer of the trauma patient. Despite a convincing volume of data against log-rolling accumulated over the years by multiple research teams and disciplines, the practice continues.[2–8] The maneuver was implemented to protect the spine and spinal cord from secondary injuries from the time of initial insult to definitive surgical interventions. Compared with other methods, however, the log roll maneuver can cause greater lateral movement of the spine,[4,5,7–11] potentially leading to neurologic deterioration[5] and increasing the risk of clot disruption at the site of internal hemorrhage.[12] Except for the prone patient, log-rolling is therefore now considered undesirable for blunt trauma patients during the initial survey.[12] The purpose of this topic brief is to examine the log roll maneuver, review alternative methods, and discuss the benefits and limitations of these different approaches.

Overview

It is estimated that 12,500 cases of spinal cord injuries occur each year.[13] Long-term survival and functional outcomes are directly related to initial management of the patient.[9] For patients with suspected traumatic spinal injuries, the spine is presumed unstable until proven otherwise.[3,4,14] Patients that arrive to the emergency department on long backboards (LBBs) are removed from them as soon as possible.[3,4,7,15] Patients with multiple trauma often require numerous exams and transfers from one area to another. Undue spinal motion can occur when patients are moved from a stretcher to a bed, possibly leading to neurologic deterioration if the spine has already been injured.[5] It is estimated that 3–25% of spinal injuries are worsened in the initial phase of management when patients are moved to a long board.[3,4] To help reduce the risk of secondary injury from patient

movement, healthcare providers need to consider where the injury is suspected and the position of the patient.[3,4]

Athletes with suspected spinal cord injuries present an additional challenge of the need for removal of protective gear. Emergency department staff need to be aware of the various types of sports equipment and the proper techniques for removing them.[16,17] Sports medicine and emergency medical services (EMS) professionals are skilled in minimizing spinal motion and therefore great resources for this information.[16] Education is needed for hospital personnel on methods to safely transfer these patients from one stretcher to another.[16,18]

Other considerations when moving patients include their age, approximated height and weight, the number of healthcare personnel available to assist, the types of devices accessible, the amount of space, and the training and education of the assisting personnel. The mechanism of injury and where and how the patient is found (e.g., patient's room, hallway, bathroom, diagnostic testing area, or other public area) are also taken into account as healthcare providers consider transfer techniques, knowing each situation is unique.

Log Roll Maneuver

The log roll maneuver was first described in the late 1960s in the famous article "Death in a Ditch" by J. D. Farrington, the father of EMS.[19] Some of the appealing factors of the log roll maneuver are that it can easily be used to handle potential problems associated with patient position and that it has minimal personnel and strength requirements. The log roll maneuver involves one person stabilizing the cervical spine while other providers "log roll" or turn the patient to the side 90 degrees. This method is often used to remove LBBs, inspect and palpate the back, and to turn or adjust supine patients.[7,20,21] The head, shoulders, torso, and hips vary in dimensions, and when a body is rolled onto its side, these differences in width make it very difficult to maintain spinal alignment and can cause rotational movement along all axes.[3,7,22,23]

In addition, the person manually stabilizing the head and neck must follow the correct, arc-like path, and timing must be coordinated.[3,7] The log roll produces significantly greater motion in the unstable cervical spine compared with methods like the lift-and-slide, the straddle lift-and-slide, the 6-plus lift-and-slide, and the scoop stretcher.[3,4,6,7] Not only does the log roll maneuver potentially harm the patient, it also puts the healthcare staff at risk for injuries. Poor body mechanics when log-rolling a patient can contribute to musculoskeletal injuries to healthcare workers.[24] The rate of musculoskeletal injuries in healthcare occupations from overexertion is among the highest for all U.S. industries.[24] These types of injuries among emergency nurses are attributed to the strenuous job demands and are associated with a higher level of burnout.[25,26] An estimated 12% of nurses leave the profession annually because of back injuries, and more than 52% complain of chronic back pain and injuries.[27] Costs from these work-related injuries have been estimated to range from $50,000 to $80,000 per claim. [27]

According to the U.S. Bureau of Labor Statistics, direct patient care providers like emergency nurses have one of the highest rates of workplace-related injuries.[28] In healthcare settings, the greatest contributors to workers' compensation claims and costs for injury are overexertion events that often precede musculoskeletal disorders. Nearly half the injuries resulting in lost days of work result from overexertion during maneuvers primarily related to direct patient care and handling[29] such as

the straining, lifting, bending, and reaching that are required in executing the log roll maneuver and other transfer methods.

Although there is convincing research showing that the log roll produces significantly greater motion in the unstable cervical spine compared with other methods,[1–5,17] it may be the only option in certain circumstances. In addition, the log roll is useful to prevent aspiration of vomit or other secretions when suction is not available.[20,21,23] If a supine patient aspirates gastric contents from the oropharynx, immediate rotation of the patient to the lateral position is indicated. Log-rolling also remains the only feasible option for back-boarding the prone patient or in circumstances where no more than four rescuers are available.[3,6]

Alternative Patient Transfer Methods

Current research and recommendations favor safer alternatives over the log roll maneuver.[1-10,17,23,30-31,34-36] By using these other methods, overall cumulative motion to the unstable spine can be reduced by approximately 50%.[3,4] The amount of spinal motion produced during transfer to a LBB increases with the severity of the cervical spine injury,[3,23] and the log roll maneuver produces more movement in thoracolumbar injuries than any other technique.[3,4] Understanding that the LBB is an extrication tool intended to facilitate transfer of a patient to a transport stretcher or cart and not for achieving spinal motion restriction,[37-45] the following are brief descriptions of various alternatives to the log-rolling maneuver:

Lift-and-Slide and the 6-Plus Lift-and-Slide

Two common methods of transferring a patient onto a stable surface like a LBB or onto a stretcher are the log roll maneuver and the lift-and-slide. While the lift-and-slide might result in less motion, it often is not feasible as it requires several feet of space around the patient on each side and generally six to eight or more staff, although it has been performed with fewer.[10,30] When performed with less assistance, one individual manually maintains inline stabilization of the cervical spine, while the other three people lift the torso, pelvis, and lower extremities. A fifth person can assist with placement or removal of the LBB. In the 6-plus lift-and-slide method, one individual maintains inline stabilization of the cervical spine while the other six people are positioned on each side of the chest, pelvis, and legs to help with the lift. An eighth person assists with the long backboard, hence the name, 6-plus lift-and-slide. The patient is then lifted 10–20 centimeters, and the LBB slid beneath the patient who is then carefully lowered onto the board.[4]

In contrast to the log roll maneuver, the lift-and-slide technique relies heavily on both the strength and coordination of healthcare providers. This technique is sometimes only appropriate for transferring patients found in the supine position.[2,16] Regardless of these limitations, there is some benefit to implementing this method when the individual requiring transfer is dressed in protective clothing (e.g., sports equipment), because it prevents rolling the patient over bulky sheets or pads.[2,16,31] Consequently, the lift-and-slide technique is extremely effective at minimizing the creation of unwanted spinal movement.[2,16] Compared with the log roll, it reduces flexion/extension, axial rotation, lateral bending, medial/lateral translation, and anterior/posterior translation.[7]

In facilities with limited staffing such as rural hospitals or critical access hospitals, the lift-and-slide may be difficult to implement because it requires more people than may be available in an emergency situation. In those instances, the log roll

may be the only option.[3] Nevertheless, current research suggests using the lift-and-slide technique wherever possible when removing a patient with a spinal injury from an LBB.[4]

Straddle Lift and Slide

The straddle lift-and-slide method is very similar to the lift-and-slide. One of the major differences is that it is used to lift the patient from the ground.. This technique is sometimes used in prehospital scenarios, but can be used in the hospital setting if a patient is on the ground. Five rescuers are required, one to manually maintain inline cervical spine stabilization, three lifters to "straddle" (squat with feet spread wide apart over the patient's body at the chest, pelvis, and lower extremities), and one positioned to assist with the LBB. The patient is lifted 10–20 centimeters, the LBB is slid beneath the patient from the feet, and the patient is lowered onto the board.[4] This method is often implemented in sports medicine or at the scene of an injury.

Healthcare providers performing this technique must be familiar with proper body mechanics to avoid injuring themselves. Other limitations to applying this technique include excessive height and weight of the patient and the availability of space and adequately trained personnel. Also, this method cannot be used with the prone patient.[32]

The advantages of this method are that it avoids the difficulty of rolling the patient's head and torso as a single unit, avoids rolling the patient over bulky clothing or equipment, and minimizes misalignment caused by proportional differences between the patient's upper body and lower extremities.[32]

Assistive Devices for Safe Patient Handling

Mechanical Continuous Lateral Rotation Therapy

Patients with spinal cord injuries are at high risk for complications related to prolonged immobilization. To reduce this risk, it is important to change body positions on a regular basis without compromising the neurological stability of the patient. One method is continuous lateral rotation therapy. This uses a specially equipped kinetic bed with an automatic turning device that completely immobilizes the patient while rotating around a horizontal axis anywhere from 90 degrees to 270 degrees, depending on the specific bed.[33] Kinetic bed therapy is often used in critical care,[34] but rarely in the emergency setting. For emergency nurses to be better able to advocate for trauma patients in the continuum of care, it is useful to know about this therapy, how it works, and its advantages and disadvantages.

Slide Boards, Slide Sheets, and Roller Boards

Slide boards, slide sheets, and roller boards are standard equipment in hospitals for assisting in the transfer of patients. A common practice for performing lateral stretcher or bed transfers is to log roll the patient onto a transfer board such as a slide board or roller board, and then transfer the patient from one stretcher or bed to the adjacent bed. Lateral transfers are also increasingly done by using slide sheets. This method involves tucking a slide sheet slightly under the patient and does not always require log-rolling. Many of the other devices still require concurrent use of the log roll maneuver, which may cause cervical and lumbar angulation to increase significantly.[5]

While some of the advantages of using these devices include convenience and use of the minimal staff,, the log roll maneuver, which is used with many of these devices, can cause statistically significant additional motion in the spine.[5] Moreover, as previously noted, these devices still require significant physical work (e.g., straining, lifting, bending, pushing, pulling and reaching) to laterally move the patient, which places healthcare providers at risk for work-related injuries. Air-assisted devices and other equipment are available that require less healthcare provider effort.

Air-assisted devices

Compared with other methods, air-assisted devices result in significantly less lumbar rotation. Examples of air-assisted devices include vacuum splints and transfer mattresses. Vacuum splints are flexible, waterproof shells, filled with polystyrene beads.[35] A vacuum splint is malleable, and healthcare providers can adjust or push the beads into the crevices and voids between the patient. Once air is withdrawn from the splint, however, it conforms to the shape of the patient and becomes rigid. A vacuum mattress is an inflatable transfer mattress that is placed under the patient and inflated by a pump or compressed air cylinder. Studies have shown that the use of vacuum mattresses for transfer results in 50% less cervical spine motion compared with a rolling board or slide board.[5] How much motion is too much for patients with spinal injuries has yet to be determined. If a burst fracture is present, the assumption is that minimal movement could lead to neural tissue damage by the bony fragments in the spinal column.[4]

Some of the advantages of the vacuum splint over the rigid backboard are that it offers improved fit to body contours,[5,36] and patients report that vacuum splint devices and transfer mattresses are more comfortable.[35] Vacuum splints are also quicker to apply and permit less body movement.[35] A vacuum mattress can be an alternative to the scoop stretcher (described below), particularly if transport time is in excess of 45 minutes.[8] Use of this device is associated with the least incidence of skin breakdown.[8] Lastly, some vacuum splints and mattresses have handles on the sides, making it easier for healthcare providers to move and transfer patients.

There still may be the need to transfer the patient to the air-assisted device unless, as a way to avoid the log roll entirely, healthcare providers place the device on the stretcher or bed immediately prior to the patient's arrival by EMS. This may not always be feasible, however, and patients still need to be rotated or turned for a posterior examination as part of a full spinal assessment.

Scoop Stretcher

The scoop stretcher is another alternative to the rigid backboard and eliminates the need to log roll a patient.[6,8] It is an adjustable device that splits into two hinged and interlocking pieces along its longitudinal axis.[6] Since each of the halves is wedge-shaped in cross-section, the two halves can be inserted beneath the patient without the need for log-rolling or lifting,[6] further reducing the risk of disrupting spinal alignment.[8] Four rescuers are usually required: one manually maintains cervical stabilization, one is located at shoulder level on each side, and one is located at the feet.

Another advantage of the scoop stretcher is that it does not require additional movements for rescuers to position the patient onto the stretcher.[6] Because the patient does not need to be log-rolled or lifted into position on the scoop stretcher, the only event that may potentially create spinal motion is the process of interlocking the scoop stretcher halves and adjusting beneath the head of the patient.[6] However, the amount of spinal motion during this process is comparable to

or less than that produced with the lift-and-slide.[6] Some scoop stretcher models also allow the patient to remain on the device while being placed in the computed topography (CT) scanner, and this feature further reduces the number of patient transfers.[8] Additionally, the use of the scoop stretcher may reduce the risk for pressure ulcers.[8]

Limitations of the scoop stretcher are related to functionality or suitability for long distance transports, cost, weight, and absence of custom design for immobilization of the head and neck.[8] As with other assistive devices, avoiding the log roll maneuver requires the patient to be supine.

Conclusion

There is substantial evidence that the log roll maneuver can cause excessive spinal movement for a patient with a potential spinal injury. Because it is impossible to measure how much spinal motion is necessary to cause neurologic damage, any movement must be regarded as potentially detrimental.[7] Most of the various techniques and alternative methods reviewed in the literature were tested on healthy volunteers or cadavers in controlled environments, not in an emergency room setting. Studies on injured patients would help assess the potential risks to the patient's spine as well as to the healthcare workers during the normal course of their activities. Furthermore, for athletes with a possible spinal injury, there is a need to assess the effects of measures taken to remove their protective gear. Education of hospital personnel is needed to achieve the safe transfer of these patients from one stretcher to another.[16]

Current transfer techniques such as the log roll maneuver cause considerable spinal movement, increase the potential for further injury, and do not adequately address the prone patient.[2–8] The log roll produces significantly greater motion in the unstable cervical spine compared with the straddle lift, the 6-plus lift-and-slide, and the scoop stretcher.[3,4,6,7] However, some of the alternative methods or techniques reviewed here also have their disadvantages, such as requiring more healthcare providers than may be available at some facilities.

Moreover, numerous studies have shown that the initial capital investment in safe patient handling policies and equipment that protect patients and healthcare staff from further additional injuries can be recuperated in fewer than five years.[45–50] Despite these findings, further research is needed to help determine which equipment and handling policies are best. Additional research is needed on spinal column movement to investigate potentially safer techniques.[3–5] To minimize risks to the patient and the healthcare workers every time a patient with a potential spinal injury has to be moved requires careful selection of the best workable option, always bearing in mind the potential issues with the log roll maneuver.

Definitions of Terms

Air-assistive devices: Devices for immobilization and transfer of patients that use air or other materials such as polystyrene balls to conform to the shape of the patient. Vacuum splints and vacuum mattresses are two such devices.

Continuous lateral therapy (CLT): Automatic mechanical rotation of a patient using a specially equipped kinetic bed that completely immobilizes the patient while rotating around a horizontal axis anywhere from 90 degrees to 270 degrees, depending on the specific bed.

Log roll maneuver: A patient-turning maneuver that requires one healthcare provider to stabilize the cervical spine while a second "log rolls" or turns the patient 90 degrees onto his or her side. This method is often used to remove LBBs, to inspect and palpate the back, and to turn or adjust patients when in the supine position.

Scoop stretcher: The scoop stretcher is an adjustable LBB device that splits into two hinged and interlocking pieces along its longitudinal axis.

6-plus lift-and-slide: Typically, eight rescuers are required; one to manually maintain inline cervical spine stabilization, three on each side of the patient in pairs at chest, pelvis, and lower extremities; one final person to slide the board beneath the patient from the feet. The patient is lifted 10-20 centimeters, the LBB is slid beneath the patient, and the patient is then carefully lowered onto the board.[4]

Slide sheet: Low friction fabric sheets designed for patients to glide over during lateral transfer.

Straddle lift: Five rescuers are required, one to maintain inline cervical spine stabilization, three to straddle the body at chest, pelvis, and lower extremities, and one to position the LBB. The patient is lifted 10-20 centimeters, the LBB is slid beneath the patient from the feet, and the patient is then carefully lowered onto the board.[4]

Authors

Authored by the 2015 Trauma Committee
Pete A. Benolken, MSN, RN, CEN, CPEN, PHN
Heidi Gilbert, ADN, RN, SANE
Maria Tackett, EdD, MSN, CEN, CCRN
Coleen Vessely, BSN, RN, CEN

ENA 2015 Board of Directors Liaison
Patricia Kunz Howard, PhD, RN, CEN, CPEN, NE-BC, FAEN, FAAN

ENA Staff Liaison
Monica Escalante Kolbuk, MSN, BA, RN

References

1. Aresti, N. A., Grewal, I. S., & Montgomery, A. S. (2014). The initial management of spinal injuries. *Orthopaedics and Trauma, 28*(2), 63–69. doi:http://dx.doi.org/10.1016/j.mporth.2014.02.004
2. Boissy, O., Shrier, I., Brière, S., Mellete, J., Fecteau, L., Matheson, G. O., … Steele, R. J. (2011). Effectiveness of cervical spine stabilization techniques. *Clinical Journal Sport of Medicine, 21*(2), 80–88. doi:10.1097/JSM.0b013e31820f8ad5
3. Conrad, B. P., Marchese, D. L., Rechtine, G. R., & Horodyski, M. (2012). Motion in the unstable thoracolumbar spine when spine boarding a prone patient. *The Journal of Spinal Cord Medicine, 35*(1), 53–57. doi:10.1179/2045772311Y.0000000045.
4. Conrad, B. P, Rossi, G. D., Horodyski, M. B., Prasarn, M. L., Alemi, Y., & Rechtine, G. R. (2012). Eliminating log rolling as a spine trauma order. *Surgical Neurology International, 3*(Suppl 3),188–197. doi:10.4103/2152-7806.98584
5. Hu, C. T., DiPaola, C. P., Conrad. B. P. Horodyski, M., Del Rossi, G., & Rechtine, G. R. (2013). Motion is reduced in the unstable spine with use of mechanical devices for bed transfers. *The Journal of Spinal Cord Medicine, 36*(1), 58–65. doi:10.1179/2045772312Y.0000000027
6. Del Rossi, G., Rechtine, G. R., Conrad, B. P., & Horodyski, M. (2010). Are scoop stretchers suitable for use on spine-injured patients? *American Journal of Emergency Medicine, 28*(7), 751–756. doi:10.1016/j.ajem.2009.03.014
7. Horodyski, M., Conrad, B. P., Del Rossi, G., DiPaola, C. P., & Rechtine, G. R. (2011). Removing a patient from the spine board: Is the lift and slide safer than the log roll? *The Journal of Trauma-Injury Infection and Critical Care 70*(5), 1282–1285. doi:10.1097/TA.0b013e31820ff2bc
8. Moss, R., Porter, K., & Greaves, I. (2015). Minimal patient handling: A faculty of pre-hospital care consensus statement. *Trauma, 17*(1), 70–72. Retrieved from http://dx.doi.org/10.1177/1460408614556439
9. Taneja, A., Berry, C. A., & Rao, R. D. (2013). Initial management of the patient with cervical spine injury. *Seminars in Spine Surgery, 25*(1), 2–13. Retrieved from http://dx.doi.org/10.1053/j.semss.2012.07.005
10. Del Rossi, G., Horodyski, M. H., Conrad, B. P., DiPaola, C. P., DiPaola, M. J., & Rechtine, G. R. (2008). The 6-plus-person lift transfer technique compared with other methods of spine boarding. *Journal of Athletic Training, 43*(1), 6–13. doi:10.4085/1062-6050-43.1.6
11. Weber, S. R., Rauscher, P., & Winsett, R. P. (2015). Comparison of a padded patient litter and long spine board for spinal immobilization in air medical transport. *Air Medical Journal, 34*(4), 213–217. doi:10.1016/j.amj.2015.03.004
12. Leech, C., Porter, K. & Bosanko, C. (2014). Log-rolling a blunt major trauma patient is inappropriate in the primary survey. *Emergency Medicine Journal, 31*(1), 86. doi:10.1136/emermed-2013-203283
13. National Spinal Cord Injury Statistical Center. (2015). *Spinal cord injury (SCI) facts and figures at a glance*. Retrieved from: https://www.nscisc.uab.edu/Public/Facts%202015%20Aug.pdf
14. American College of Surgeons Committee on Trauma. (2012). *Advanced trauma life support for doctors* (8th ed). Chicago, IL: American College of Surgeons
15. Emergency Nurses Association, (2015). *ENA's translation into practice: Long backboard use for spinal motion restriction.* Retrieved from: https://www.ena.org/practice-research/Practice/Documents/LongBackboardUse.pdf
16. Casa, D. J., Guskiewicz, K. M., Anderson, S. A., Courson, R. W., Heck, J. F., Jiminez, C. C.,… Walsh, K. M. (2012). National Athletic Trainers' Association position statement: Preventing sudden death in sports. *Journal of Athletic Training, 47*(1), 96–118

17. Kanwar, R., Delasobera, B. E., Hudson, K., & Frohna, W. (2015). Emergency department evaluation and treatment of cervical spine injuries. *Emergency Medicine Clinics of North America, 33*(2), 241–282. doi:10.1016/j.emc.2014.12.002
18. Shrier, I., Boissy, P., Brière, S., Mellete, J., Fecteau, L., Matheson, G. O., … Steele, R. J. (2012). Can a rescuer or simulated patient accurately assess motion during cervical spine stabilization practice sessions? *Journal of Athletic Training, 47*(1) 42–51.
19. Farrington, J. D. (1967). Death in a ditch. *American College of Surgeons Bulletin, 52*(3), 121–132.
20. American College of Surgeons, (2012). *Advanced Trauma Life Support* (9th ed.). Chicago, IL: Author.
21. Emergency Nurses Association, (2014). *TNCC™: Trauma nursing core course provider manual* (7th ed.). Des Plaines, IL: Author.
22. Prasarn, M. L., Horodyski, M., Dubose, D., Small, J., Del Rossi, G., Zhou, H., … Rechtine G. R. (2012). Total motion generated in the unstable cervical spine during management of the typical trauma patient: *Spine, 37*(11), 937–942. A comparison of methods in a cadaver model. *Spine, 37*(11), 937–942. doi:10.1097/BRS.0b013e31823765af
23. Rowell, W. (2014). When emergency nurses should drop the log-rolling manoeuvre. *Emergency Nurse, 22*(4), 32–33. doi:10.7748/en.22.4.32.e1324
24. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. (2015). *Workplace safety & health topics: Safe patient handling.* Retrieved from http://www.cdc.gov/niosh/topics/safepatient/
25. Heiden, B., Weigl, M., Angerer, P., & Muller, A. (2013). Association of age and physical job demands with musculoskeletal disorders in nurses. *Applied Ergonomics, 44*(4), 652–658. doi: 10.1016/j.apergo.2013.01.001
26. Sorour, A. S., & El-Maksoud, M. M. (2012). Relationship between musculoskeletal disorders, job demands, and burnout among emergency nurses. *Advanced Emergency Nursing Journal, 34*(3), 272–282. doi:10.1097/TME.0b013e31826211e1
27. Hunter, B., Branson, M., & Davenport, D. (2010). Saving costs, saving health care providers' backs, and creating a safe patient environment. *Nursing Economic$, 28*(2), 130–134
28. U.S. Department of Labor, Bureau of Labor Statistics. (2013). *Nonfatal occupational injuries and illness requiring days away from work, 2012*. (BLS Publication No. USDL-13_2257). Retrieved from http://www.bls.gov/news.release/archives/osh2_11262013.pdf
29. U.S. Department of Labor, Occupational Safety and Health Administration. (2013). *Worker safety in your hospital: Know the facts.* (OSHA Publication No. 3689). Retrieved from https://www.osha.gov/dsg/hospitals/documents/1.1_Data_highlights_508.pdf
30. Whooley, S. (2015). *Beyond backboards: Moving and extricating trauma patients*. Retrieved from: http://www.ems1.com/backboard-stretcher/articles/2165375-Beyond-backboards-Moving-and-extricating-trauma-patients/
31. Prasarn, M. L., Horodyski, M, DiPaola, M. J., Di Paola, C. P., Del Rossi, G, Conrad, B. P., & Rechtine, G. R. (2015). Controlled laboratory comparison study of motion with football equipment in a destabilized cervical spine: Three spine-board transfer techniques. *The Orthopaedic Journal of Sports Medicine, 3*(9); 1-5. doi:10.1177/2325967115601853
32. Casa, D. J., & Stearns, R. L. (2015). *Emergency management for sport and physical activity.* Burlington, MA: Jones & Bartlett Learning.

33. Goldhill, D. R., Imhoff, M., McLean, B., & Waldmann, C. (2007). Rotational bed therapy to prevent and treat respiratory complications: A review and meta-analysis. *American Journal of Critical Care, 16*(1); 50–61.
34. Prasarn, M. L., Horodyski, M., Behrend, C., Del Rossi, G., Dubose, D., & Rechtine, G. R. (2015). Is it safe to use a kinetic therapy bed for care of patients with cervical spine injuries? *Injury, 46*(2), 388–391. doi:10.1016/j.injury.2014.10.049
35. Navarro, K. (2014). Vacuum spine boards: Transport devices of the future. Retrieved from the EMS1.com website http://www.ems1.com/immobilization/articles/1680079-Vacuum-spine-boards-Transport-devices-of-the-future/
36. Shrier, I., Boissy, P., Lebel, K., Boulay, J., Segal, E., Delaney, J. S., … Steele, R.J. (2015). Cervical spine motion during transfer and stabilization techniques. *Prehospital Emergency Care*, *19*(1), 116–125.
37. Oteir, A. O., Smith, K., Stoelwinder, J. U., Middleton, J., & Jennings, P. A. (2015). Should suspected cervical spinal cord injury be immobilised? A systematic review. *Injury, 46*(4), 528–535. doi:10.1016/j.injury.2014.12.032
38. Connor, D., Greaves, I., Porter, K., & Bloch, M. (2013). Pre-hospital spinal immobilization: An Initial consensus statement. *Emergency Medicine Journal, 30*(12), 1067–1069. doi:10.1136/emermed-2013-203207
39. Alson, R., & Copeland, D. (2014). *Long backboard use for spinal motion restriction of the trauma patient*. Retrieved from the International Trauma Life Support website: https://www.itrauma.org/wp-content/uploads/2014/05/SMR-Resource-Document-FINAL.pdf
40. White, C. C., Domeier, R. M., Millin, M. G., & Standards and Clinical Practice Committee, National Association of EMS Physicians. (2014). EMS spinal precautions and the use of the long backboard – resource document to the position statement of the National Association of EMS Physicians and the American College of Surgeons Committee on Trauma. *Prehospital Emergency Care, 18*(2), 306–314. doi:10.3109/10903127.2014.884197
41. Canadian Agency for Drugs and Technologies in Health. (2013). *The use of spine boards in the pre-hospital setting for the stabilization of patients following trauma: A review of the clinical evidence and guidelines*. Retrieved from https://www.cadth.ca/use-spine-boards-pre-hospital-setting-stabilizationpatients-following-trauma-review-clinical
42. Theodore, N., Hadley, M. N., Aarabi, B., Dhall, S. S., Gelb, D. E., Daniel, E., … Walters. B. C. (2013). Prehospital cervical spinal immobilization after trauma. *Neurosurgery, 72*(2), 22–34. doi:10.1227/NEU.0b013e318276edb1
43. Hauswald, M. (2013). A re-conceptualisation of acute spinal care. *Emergency Medicine Journal, 30*(9), 720–723 doi:10.1136/emermed-2012-201847
44. Moss, R., Porter, K., & Greaves, I. (2013). Minimal patient handling: A faculty of prehospital care consensus statement. *Emergency Medicine Journal, 30*(12), 1065–1066. doi:10.1136/emermed-2013-203205
45. Emergency Nurses Association, (2014). *Translation Into Practice: Long Backboard use for spinal motion restriction*. Des Plaines, IL: Author. Retrieved from: https://www.ena.org/practice-research/Practice/Documents/LongBackboardUse.pdf
46. Garg, A. (1999). *Long-term effectiveness of "Zero-Lift Program" in seven nursing homes and one hospital* (National Institute for Occupational Safety and Health, Contract Report No. 460/CCU512089-2). Retrieved from http://www4.uwm.edu/ergonomics/research/upload/Zero-Lift_Report.pdf
47. Nelson, A., Matz, M., Chen, F., Siddharthan, K., Lloyd, J., & Fragala, G. (2006). Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. *International Journal of Nursing Studies, 43*(6), 717–733.

48. Nelson A. L., Collins, J., Knibbe, H.,. Cookson, K., de Castro, A. B., & Whipple, K. L. (2007). Safer patient handling. *Nursing Management, 38*(3): 26–32. doi:10.1097/01.NUMA.0000262923.39562.0e
49. Siddharthan, K., Nelson, A., Tiesman, H., & Chen, F. (2005). Cost effectiveness of a multifaceted program for safe patient handling. In K. Henriksen, J. B. Battles, & E. S. Marks (Eds.), *Advances in Patient Safety: From research to implementation* (pp. 347–358). Retrieved from http://www.ahrq.gov/downloads/pub/advances/vol3/Siddharthan.pdf
50. American Nurses Association (2013). *Safe patient handling and mobility: Interprofessional national standards*. Silver Spring, MD: Author.

Developed: 2016.

Approved by the ENA Board of Directors: February, 2016.

Disclaimer