

Spinal Motion Restriction Bibliography

1. EMS spinal precautions and the use of the long backboard.

Prehosp Emerg Care. 2013 Jul Sep; 17(3):392-3.

- This is the official position of the National Association of EMS Physicians and the American College of Surgeons Committee on Trauma regarding emergency medical services spinal precautions and the use of the long backboard.

The National Association of EMS Physicians and the American College of Surgeons Committee on Trauma believe that:

- Long backboards are commonly used to attempt to provide rigid spinal immobilization among emergency medical services (EMS) trauma patients.
- However, the benefit of long backboards is largely unproven.
- The long backboard can induce pain, patient agitation, and respiratory compromise. Further, the backboard can decrease tissue perfusion at pressure points, leading to the development of pressure ulcers.
- Utilization of backboards for spinal immobilization during transport should be judicious, so that the potential benefits outweigh the risks.
- Appropriate patients to be immobilized with a backboard may include those with:
 - Blunt trauma and altered level of consciousness
 - Spinal pain or tenderness
 - Neurologic complaint (e.g., numbness or motor weakness)
 - Anatomic deformity of the spine
 - High-energy mechanism of injury and any of the following:
 - Drug or alcohol intoxication
 - Inability to communicate
 - Distracting injury
- Patients for whom immobilization on a backboard is not necessary include those with all of the following:
 - Normal level of consciousness (Glasgow Coma Score [GCS] 15)
 - No spine tenderness or anatomic abnormality
 - No neurologic findings or complaints
 - No distracting injury
 - No intoxication
- Patients with penetrating trauma to the head, neck, or torso and no evidence of spinal injury should not be immobilized on a backboard.
- Spinal precautions can be maintained by application of a rigid cervical collar and securing the patient firmly to the EMS stretcher, and may be most appropriate for:
 - Patients who are found to be ambulatory at the scene
 - Patients who must be transported for a protracted time, particularly prior to interfacility transfer
 - Patients for whom a backboard is not otherwise indicated
- Whether or not a backboard is used, attention to spinal precautions among at-risk patients is paramount. These include application of a cervical collar, adequate

security to a stretcher, minimal movement/transfers, and maintenance of inline stabilization during any necessary movement/transfers.

- Education of field EMS personnel should include evaluation of the risk of spinal injury in the context of options to provide spinal precautions.
 - Protocols or plans to promote judicious use of long backboards during prehospital care should engage as many stakeholders in the trauma/EMS system as possible.
 - Patients should be removed from backboards as soon as practical in an emergency department.
2. 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. Prehosp Emerg Care. April-June 2014, Vol. 18, No. 2, Pages 306-314
 - This is the support/resource document for the above NAEMSP document
 3. Hauswald M. A re-conceptualization of acute spinal care. Emerg Med J. 2013 Sep; 30(9):720-3.
 - This very thoughtful and helpful paper framed much of the thinking that has gone into revitalizing pre-hospital immobilization.

Abstract: The emergency care of patients who may have spinal injuries has become highly ritualized. There is little scientific support for many of the recommended interventions and there is evidence that at least some methods now used in the field and emergency department are harmful. Since prospective clinical trials are not likely to resolve these issues I propose a reconceptualization of spinal trauma to allow a more rational approach to treatment. To do this I analyze the basic physics, biomechanics and physiology involved. I then develop a list of recommended treatment variations that are more in keeping with the actual causes of post impact neurological deterioration than are current methods. Discarding the fundamentally flawed emphasis on decreasing post injury motion and concentrating on efforts to minimize energy deposition to the injured site, while minimizing treatment delays, can simplify and streamline care without subjecting patients to procedures that are not useful and potentially harmful. Specific treatments that are irrational and which can be safely discarded include the use of backboards for transportation, cervical collar use except in specific injury types, immobilization of ambulatory patients on backboards, prolonged attempts to stabilize the spine during extrication, mechanical immobilization of uncooperative or seizing patients and forceful in line stabilization during airway management.

4. Dixon M, O'Halloran J, Cummins NM. Biomechanical analysis of spinal immobilisation during prehospital extrication: a proof of concept study. Emerg Med J. 2013 Jun 28.
 - Background. In most countries, road traffic collisions (RTCs) are the main cause of cervical spine injuries. There are several techniques in use for spinal immobilization during prehospital extrication; however, the evidence for these is

poor. The aim of this study was **to establish which rescue technique provides the minimal deviation of the cervical spine from the neutral inline position during the extrication of the RTC patient using biomechanical analysis techniques.**

- **Methods.** A simulated male patient (weight 80 kg, height 180 cm) was fitted with a cervical collar and extricated from a prepared motor vehicle with roof removed and standard Emergency medical services safety measures in place. A rescue crew of four firefighter first responders and two paramedics **performed eight different extrication techniques.** The patient was marked with biomechanical sensors in the midline and in two horizontal planes at the level of the forehead and clavicles, respectively. Relative movement between the sensors was captured via 12 infrared high-speed motion-analysis cameras recording at 200 Hz. A virtual three-dimensional mathematical model was developed from the recorded movement. **Results.** Control measurements were taken from the patient during self-extrication under verbal instruction and movement was recorded of 4.194° left of midline (LOM) to 2.408° right of midline (ROM), resulting in total movement of 6.602°. In comparison, the minimum deviation recorded during equipment-aided extrication (long spinal board and/or extrication device) was movement of 3.365° LOM and 8.352° ROM, resulting in total movement of 11.717°. The maximum deviation recorded during equipment-aided extrication was movement of 1.588° LOM and 24.498° ROM, resulting in total movement of 26.086°.
- **Conclusions. Standard extrication techniques cause up to four times more cervical spine movement during extrication than controlled self-extrication.**

5. Engsborg JR, Standeven JW, Shurtleff TL, Eggars JL, Shafer JS, Naunheim RS. Cervical spine motion during extrication. J Emerg Med. 2013 Jan;44(1):122-7.

- **Background:** It has been estimated that up to one-quarter of spinal cord injuries may be significantly worsened during extrication or early treatment after a motor vehicle accident.
- **Study Objectives:** The purpose of this study was to analyze the planar motions of the head relative to the torso during extrication from an automobile in a laboratory setting.
- **Methods:** Video motion capture was used to quantify the range of motion of the head relative to the torso in 10 participants as they were extricated from a mock motor vehicle during four different extrication techniques: 1) Unassisted Unprotected, 2) Unassisted Protected with a cervical collar (CC), 3) Assisted and Protected with a CC, and 4) Assisted and Protected with a CC and Kendrick Extrication Device.
- **Results:** The results indicated a significant decrease in movement for all motions when the driver exited the vehicle unassisted with CC protection, compared to exiting unassisted and without protection. Decreases in movement were also observed for an event (i.e., Pivot in seat) during extrication with paramedic assistance and protection. However, no movement reduction was observed in another event (i.e., Recline on board) with both paramedic assistance and protection.

- Conclusion: **In this study, no decrease in neck movement occurred for certain extrication events that included protection and assistance by the paramedics. Future work should further investigate this finding.**
6. Leonard JC, Mao J, Jaffe DM. Potential Adverse Effects of Spinal Immobilization in Children. *Prehosp Emerg Care.* Oct-Dec 2012, 16(4) , pp 513-518.
- Objective. The purpose of our study was **to describe potential adverse effects associated with spinal immobilization following trauma among children.**
 - Methods. We conducted a prospective cohort study of children presenting to the emergency department (ED) **for evaluation following trauma** over a 13-month period. Children were eligible if they underwent spinal immobilization prior to physician evaluation or if they met the American College of Surgeons (ACS) guidelines for spinal immobilization but were not immobilized. We compared children who were immobilized with those who were not immobilized for self-reported pain, use of radiography to evaluate the cervical spine, ED length of stay, and ED disposition. We also report the characteristics of the cohort.
 - Results. One hundred seventy-three spine-immobilized children and 112 children who met ACS criteria but were not immobilized were enrolled. There were differences between the two study groups, which included age, mechanism of injury, and proportion transported by emergency medical services. However, the comparison groups had comparable Pediatric Trauma Scores (PTSs) and Glasgow Coma Scale scores (GCSs). Immobilized children had a higher median pain score (3 versus 2) and were more likely to undergo cervical radiography (56.6% versus 13.4%) and be admitted to the hospital (41.6% versus 14.3%). The comparison groups had similar lengths of stay in the ED.
 - Conclusion. Despite presenting with comparable PTSs and GCSs, **children who underwent spinal immobilization following trauma had a higher degree of self-reported pain, and were much more likely to undergo radiographic cervical spine clearance** and be admitted to the hospital than those who were not immobilized. Future studies are warranted to determine whether these differences are related to spinal immobilization or differences in the mechanisms of injury, injury patterns, or other variables.
7. Stuke LE, Pons PT, Guy JS, Chapleau WP, Butler FK, McSwain NE. Prehospital spine immobilization for penetrating trauma--review and recommendations from the Prehospital Trauma Life Support Executive Committee. *J Trauma.* 2011 Sep;71(3):763-9; discussion 769-70.
- This paper from the Prehospital Trauma Life Support (PHTLS) Executive Committee provides a literature review and recommendations. In summary the PHTLS recommendations are:
 - There are no data to support routine spine immobilization in patients with penetrating trauma to the neck or torso.
 - There are no data to support routine spine immobilization in patients with isolated penetrating trauma to the cranium.

- Spine immobilization should never be done at the expense of accurate physical examination or identification and correction of life-threatening conditions in patients with penetrating trauma.
 - Spinal immobilization may be performed after penetrating injury when a focal neurologic deficit is noted on physical examination although there is little evidence of benefit even in these cases.
8. Haut ER, Kalish BT, Efron DT, Haider, AH. Stevens KA, Kieninger AN, Cornwell EE, Chang DC. Spine Immobilization in Penetrating Trauma: More Harm Than Good? *J Trauma*. 2010;68: 115–121
- Background: Previous studies have suggested that prehospital spine immobilization provides minimal benefit to penetrating trauma patients but takes valuable time, potentially delaying definitive trauma care. We hypothesized that penetrating trauma patients who are spine immobilized before transport have higher mortality than nonimmobilized patients.
 - Methods: We performed a retrospective analysis of penetrating trauma patients in the National Trauma Data Bank (version 6.2). Multiple logistic regression was used with mortality as the primary outcome measure. We compared patients with versus without prehospital spine immobilization, using patient demographics, mechanism (stab vs. gunshot), physiologic and anatomic injury severity, and other prehospital procedures as covariates. Subset analysis was performed based on Injury Severity Score category, mechanism, and blood pressure. We calculated a number needed to treat and number needed to harm for spine immobilization.
 - Results: In total, 45,284 penetrating trauma patients were studied; 4.3% of whom underwent spine immobilization. Overall mortality was 8.1%. **Unadjusted mortality was twice as high in spine-immobilized patients (14.7% vs. 7.2%, p = 0.001). The odds ratio of death for spine-immobilized patients was 2.06 (95% CI: 1.35–3.13) compared with nonimmobilized patients.** Subset analysis showed consistent trends in all populations. Only 30 (0.01%) patients had incomplete spinal cord injury and underwent operative spine fixation. The number needed to treat with spine immobilization to potentially benefit one patient was 1,032. The number needed to harm with spine immobilization to potentially contribute to one death was 66.
 - Prehospital spine immobilization was associated with higher odds of death in all penetrating trauma patients, and this association was qualitatively robust across all subsets of penetrating trauma patients.
 - **Conclusions: Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.**
9. Kwan I, Bunn F. Effects of Prehospital Spinal Immobilization: A Systematic Review of Randomized Trials on Healthy Patients. *Prehosp Dis Med*. 2005 20(1); 47-53
- Results: 17 randomized control trials compared different devices (collars, backboards, splints, and body strapping). For immobilization efficiency, collars, spine boards, vacuum splints and abdominal/torso strapping provided a significant

reduction in spinal movement. **Adverse effects of spinal immobilization included a significant increase in respiratory effort, skin ischemia, pain, and discomfort.**

10. Hauswald M, Ong G, Tandberg D, Omar Z. Out-of-hospital spinal immobilization: its effect on neurologic injury. *Acad Emerg Med.* 1998 Mar;5(3):214-9.

- This was an interesting study on this topic that compared the EMS system in New Mexico to a trauma center in Malaysia, where no EMS system existed, but otherwise all other variables (population, hospital volume, hospital resources, injury severity score of the patients) were the same. **This 5 year retrospective study of the two populations showed no clinical outcome benefit in backboarding patients. The patients transported by personal vehicle or police car in Malaysia had similar clinical outcomes to those boarded and collared by EMS in New Mexico.**
- Objective: To examine the effect of emergency immobilization on neurologic outcome of patients who have blunt traumatic spinal injuries.
- Methods: A 5-year retrospective chart review was carried out at 2 university hospitals. All patients with acute blunt traumatic spinal or spinal cord injuries transported directly from the injury site to the hospital were entered. None of the 120 patients seen at the University of Malaya had spinal immobilization during transport, whereas all 334 patients seen at the University of New Mexico did. The 2 hospitals were comparable in physician training and clinical resources. Neurologic injuries were assigned to 2 categories, disabling or not disabling, by 2 physicians acting independently and blinded to the hospital of origin. Data were analyzed using multivariate logistic regression, with hospital location, patient age, gender, anatomic level of injury, and injury mechanism serving as explanatory variables.
- Results: There was less neurologic disability in the unimmobilized Malaysian patients (OR 2.03; 95% CI 1.03-3.99; $p = 0.04$). This corresponds to a <2% chance that immobilization has any beneficial effect. Results were similar when the analysis was limited to patients with cervical injuries (OR 1.52; 95% CI 0.64-3.62; $p = 0.34$).
- Conclusion: **Out-of-hospital immobilization has little or no effect on neurologic outcome in patients with blunt spinal injuries.**

The study below describes the problem of prehospital immobilization being prolonged even after arrival at the Emergency Department.

11. Hauswald M, Braude D. Diffusion of Medical Progress: Early Spinal Immobilization in the Emergency Dept. *AEM* 2007 14:1087-108.

- Methods: phone survey 36 EDs, one state. When are pts removed from backboards? Immediate or delayed?
- Results: In 32 hospitals had a protocol; 15 immediate and 17 delayed. Physicians didn't change until someone else did so. In all but one case, the approach of immediate removal was initiated at the hospital by a physician trained or recently

working at a university facility. 8 stated that transport service requirements influenced them.

- Conclusions: “Although logic and the medical literature support removing all patients from a backboard immediately, physicians were unlikely to change their practice after their formal training had been completed until a new member of their group had done so.”
- Both the NEXUS and the Canadian C-Spine rules are based on robust studies and used regularly in-hospital. Both have been adapted and used in a widespread fashion in the pre-hospital arena. The practice of prehospital selective spine clearance has also been studied and

12. Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI. Validity of a Set of Clinical Criteria to Rule Out Injury to the Cervical Spine in Patients with Blunt Trauma *N Engl J Med* 2000; 343:94-99.

- Background: Because clinicians fear missing occult cervical-spine injuries, they obtain cervical radiographs for nearly all patients who present with blunt trauma. Previous research suggests that a set of clinical criteria (decision instrument) can identify patients who have an extremely low probability of injury and who consequently have no need for imaging studies.
- Methods: We conducted a prospective, observational study of such a decision instrument at **21 centers** across the United States. The decision instrument required patients to meet five criteria in order to be classified as having a low probability of injury: **no midline cervical tenderness, no focal neurologic deficit, normal alertness, no intoxication, and no painful, distracting injury**. We examined the performance of the decision instrument in 34,069 patients who underwent radiography of the cervical spine after blunt trauma.
- Results: The decision instrument identified all but 8 of the 818 patients who had cervical-spine injury (sensitivity, 99.0 percent [95 percent confidence interval, 98.0 to 99.6 percent]). The negative predictive value was 99.8 percent (95 percent confidence interval, 99.6 to 100 percent), the specificity was 12.9 percent, and the positive predictive value was 2.7 percent. Only two of the patients classified as unlikely to have an injury according to the decision instrument met the preset definition of a clinically significant injury (sensitivity, 99.6 percent [95 percent confidence interval, 98.6 to 100 percent]; negative predictive value, 99.9 percent [95 percent confidence interval, 99.8 to 100 percent]; specificity, 12.9 percent; positive predictive value, 1.9 percent), and only one of these two patients received surgical treatment. According to the results of assessment with the decision instrument, radiographic imaging could have been avoided in the cases of 4309 (12.6 percent) of the 34,069 evaluated patients.
- Conclusions: **A simple decision instrument based on clinical criteria can help physicians to identify reliably the patients who need radiography of the cervical spine after blunt trauma. Application of this instrument could reduce the use of imaging in such patients.**

13. Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, Worthington JR, Eisenhauer MA, Cass D, Greenberg G, MacPhail I, Dreyer J, Lee JS, Bandiera G,

Reardon M, Holroyd B, Lesiuk H, Wells GA. The Canadian C-Spine Rule versus the NEXUS Low-Risk Criteria in Patients with Trauma. N Engl J Med. 2003 Dec 25;349(26):2510-8.

- Background: The Canadian C-Spine (cervical-spine) Rule (CCR) and the National Emergency X-Radiography Utilization Study (NEXUS) Low-Risk Criteria (NLC) are decision rules to guide the use of cervical-spine radiography in patients with trauma. It is unclear how the two decision rules compare in terms of clinical performance.
- Methods: We conducted a prospective cohort study in nine Canadian emergency departments comparing the CCR and NLC as applied to alert patients with trauma who were in stable condition. The CCR and NLC were interpreted by 394 physicians for patients before radiography.
- Results: Among the 8283 patients, 169 (2.0 percent) had clinically important cervical-spine injuries. In 845 (10.2 percent) of the patients, physicians did not evaluate range of motion as required by the CCR algorithm. In analyses that excluded these indeterminate cases, the CCR was more sensitive than the NLC (99.4 percent vs. 90.7 percent, $P < 0.001$) and more specific (45.1 percent vs. 36.8 percent, $P < 0.001$) for injury, and its use would have resulted in lower radiography rates (55.9 percent vs. 66.6 percent, $P < 0.001$). In secondary analyses that included all patients, the sensitivity and specificity of CCR, assuming that the indeterminate cases were all positive, were 99.4 percent and 40.4 percent, respectively ($P < 0.001$ for both comparisons with the NLC). Assuming that the CCR was negative for all indeterminate cases, these rates were 95.3 percent ($P = 0.09$ for the comparison with the NLC) and 50.7 percent ($P = 0.001$). The CCR would have missed 1 patient and the NLC would have missed 16 patients with important injuries.
- Conclusions: **For alert patients with trauma who are in stable condition, the CCR is superior to the NLC with respect to sensitivity and specificity for cervical-spine injury, and its use would result in reduced rates of radiography.**

14. Bandiera G, Stiell IG, Wells GA, Clement C, De Maio V, Vandemheen KL, Greenberg GH, Lesiuk H, Brison R, Cass D, Dreyer J, Eisenhauer MA, Macphail I, McKnight RD, Morrison L, Reardon M, Schull M, Worthington J; Canadian C-Spine and CT Head Study Group. The Canadian C-spine rule performs better than unstructured physician judgment. Ann Emerg Med. 2003 Sep;42(3):395-402.

- Study Objectives: We compare the predictive accuracy of emergency physicians' unstructured clinical judgment to the Canadian C-Spine rule.
- Methods: This prospective multicenter cohort study was conducted at 10 Canadian urban academic emergency departments. Included in the study were alert, stable, adult patients with a Glasgow Coma Scale score of 15 and trauma to the head or neck. This was a substudy of the Canadian C-Spine and CT Head Study. Eligible patients were prospectively evaluated before radiography. Physicians estimated the probability of unstable cervical spine injury from 0% to 100% according to clinical judgment alone and filled out a data form. Interobserver assessments were done when feasible. Patients underwent cervical

spine radiography or follow-up to determine clinically important cervical spine injuries. Analyses included comparison of areas under the receiver operating characteristic (ROC) curve with 95% confidence intervals (CIs) and the kappa coefficient.

- Results: During 18 months, 6265 patients were enrolled. The mean age was 36.6 years (range 16 to 97 years), and 50.1% were men. Sixty-four (1%) patients had a clinically important injury. The physicians' kappa for a 0% predicted probability of injury was 0.46 (95% CI 0.28 to 0.65). The respective areas under the ROC curve for predicting cervical spine injury were 0.85 (95% CI 0.80 to 0.89) for physician judgment and 0.91 (95% CI 0.89 to 0.92) for the Canadian C-Spine rule (P <.05). With a threshold of 0% predicted probability of injury, the respective indices of accuracy for physicians and the Canadian C-Spine rule were sensitivity 92.2% versus 100% (P <.001) and specificity 53.9% versus 44.0% (P <.001).
- Conclusion: Interobserver agreement of unstructured clinical judgment for predicting clinically important cervical spine injury is only fair, and the sensitivity is unacceptably low. **The Canadian C-Spine rule was better at detecting clinically important injuries with a sensitivity of 100%. Prospective validation has recently been completed and should permit widespread use of the Canadian C-Spine rule.**

15. Myers LA, Russi CS, Hankins DG, Berns KS, Zietlow SP. Efficacy and compliance of a prehospital spinal immobilization guideline. Int J Emerg Med. 2009 Apr;2(1):13-7.

- Background: Prehospital spinal immobilization criteria are useful in identifying those at risk for spinal fractures, while reducing the number of patients unnecessarily immobilized. The use of immobilization criteria, without regard to mechanism of injury, has been shown to accomplish this task.
- Aims: The study's purpose is to examine efficacy of a prehospital spinal clearance guideline and triage/management of these injuries.
- Methods: This was a retrospective study of traumatically injured patients based on a clinical clearance spinal immobilization guideline between January 2006 and January 2007. Two gold standards were used in the analysis (radiographic findings and physician clearance without radiographs). This project was approved by the Mayo Clinic Institutional Review Board.
- Results: The study included 942 patients documented to have a traumatic injury. Of these, 43 (4.6%) had an acute spinal fracture. The guideline allowed 558 (59.2%) patients to be cleared, and 1.3% (7/558) had fractures. The remaining 384 did not meet clearance criteria and accounted for 36 (9.4%, 36/384) fractures. The guideline correctly predicted 36 of 43 fractures. The median age of the 7 fractures not immobilized was 82 years and of the 36 patients with fractures that were immobilized was 48 years. When immobilization was indicated, caregivers were 77.6% (298/384) compliant. Of the noncompliant 22.4% (86/384) there were 9 fractures.
- Conclusions: **This spinal guideline demonstrates efficacy in identifying those at risk for spinal fractures.** An age extreme criteria may enhance this already effective guideline. Further analysis of compliance failures may improve the guideline's ability for fracture prediction.

16. Burton JH, Dunn MG, Harmon NR, Hermanson TA, Bradshaw JR. A statewide, prehospital emergency medical service selective patient spine immobilization protocol. J Trauma. 2006 Jul;61(1):161-7.

- Background: To evaluate the practices and outcomes associated with a statewide, emergency medical services (EMS) protocol for trauma patient spine assessment and selective patient immobilization.
- Methods: An EMS spine assessment protocol was instituted on July 1, 2002 for all EMS providers in the state of Maine. Spine immobilization decisions were prospectively collected with EMS encounter data. Prehospital patient data were linked to a statewide hospital database that included all patients treated for spine fracture during the 12-month period following the spine assessment protocol implementation. Incidence of spine fractures among EMS-assessed trauma patients and the correlation between EMS spine immobilization decisions and the presence of spine fractures-stable and unstable-were the primary investigational outcomes.
- Results: There were 207,545 EMS encounters during the study period, including 31,885 transports to an emergency department for acute trauma-related illness. For this cohort, there were 12,988 (41%) patients transported with EMS spine immobilization. Linkage of EMS and hospital data revealed 154 acute spine fracture patients; 20 (13.0%) transported without EMS-reported spine immobilization interventions. This nonimmobilized group included 19 stable spine fractures and one unstable thoracic spine injury. The protocol sensitivity for immobilization of any acute spine fracture was 87.0% (95% confidence interval [CI], 81.7-92.3) with a negative predictive value of 99.9% (95% CI, 99.8-100).
- Conclusions: **The use of this statewide EMS spine assessment protocol resulted in one nonimmobilized, unstable spine fracture patient in approximately 32,000 trauma encounters. Presence of the protocol affected a decision not to immobilize greater than half of all EMS-assessed trauma patients**

17. Domeier RM, Swor RA, Evans RW, Hancock JB, Fales W, Krohmer J, Frederiksen SM, Rivera-Rivera EJ, Schork MA. Multicenter prospective validation of prehospital clinical spinal clearance criteria. J Trauma. 2002 Oct;53(4):744-50.

- Background: Spine immobilization is one of the most frequently performed prehospital procedures. If trauma patients without significant risk for spine injury complications can be identified, spine immobilization could be selectively performed. The purpose of this study was to evaluate five prehospital clinical criteria-altered mental status, neurologic deficit, spine pain or tenderness, evidence of intoxication, or suspected extremity fracture-the absence of which identify prehospital trauma patients without a significant spine injury.
- Methods: Prospectively collected emergency medical services data items included the above-listed criteria. Outcome data include spine fracture or cord injury, and also the level and management of injuries.
- Results: A total of 295 patients with spine injuries were present in 8,975 (3.3%) cases. Spine injury was identified by the prehospital criteria in 280 of 295

(94.9%) injured patients. The criteria missed 15 patients. Thirteen of 15 had stable injuries, the majority of which were stable compression or vertebral process injuries. The remaining two would have been captured by more accurate prehospital evaluation.

- Conclusion: **Absence of the study criteria may form the basis of a prehospital protocol that could be used to identify trauma patients who may safely have rigid spine immobilization withheld.** Evaluation of such a protocol in practice should be performed.