



Pre-hospital spinal injury management – PHECC position paper

Mission Statement

“The Pre-Hospital Emergency Care Council protects the public by independently specifying, reviewing, maintaining and monitoring standards of excellence for the safe provision of quality pre-hospital emergency care”

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Pre-hospital spinal injury management – PHECC position paper

Introduction

The Pre-Hospital Emergency Care Council (PHECC) has a unique position internationally in pre-hospital emergency care as it sets not only practitioner standards but also responder standards. This paper will therefore refer to both practitioner and responder in relation to pre-hospital spinal injury management.

A one-day seminar to present current practice (Ireland, UK and USA) and current research in spinal injury management was held in June 2015. The seminar was targeted at Council and Committee members of PHECC and also PHECC facilitators, tutors and assistant tutors. Fifty-five people attended the seminar; see Appendix 1 for details.

The position papers on pre-hospital spinal injury management in both the UK and USA (Connor, Greaves et al. 2013) (White, Domeier et al. 2014) were used as primary discussion documents for seminar attendees. Both papers question the continued use of protocols for immobilisation of every trauma patient and in particular the use of a long board for other than extrication. They suggest that pre-hospital practitioners should be more selective when deciding to immobilise a patient. Studies such as the NEXUS and the Canadian C-spine rule suggest that actual spinal cord injuries are the exception rather than the rule. Immobilisation of unselected patients with penetrating trauma is resulting in increased mortality and should cease (Haut, Kalish et al. 2010) (Connor, Greaves et al. 2013) is indicative for the need for change to current practice.

At the end of the seminar seven specific statements were posed to the attendees. These statements related to potential changes in the care and management of patients with suspected spinal injuries. The statements were based around the research performed in University of Limerick and the position papers on spinal injuries from the US and UK.

The preferences were 'Strongly disagree', 'Disagree', 'Neutral', 'Agree', or 'Strongly agree' with the statements.

To elicit their views and to inform consultants in emergency medicine (working in the public sector) of the spinal injury review, the survey was sent to them also. Forty-one (61%) Consultants in Emergency Medicine responded to the survey. PHECC facilitators, tutors and assistant tutors who were not in position to attend the seminar were also invited to partake in the survey. Incorporating the people that attended and did not attend the seminar a total of 103 (52%) PHECC facilitators, tutors and assistant tutors responded to the survey.

The largest cohort of responders tasked to attend potential spinal injury in Ireland are firefighters. In attempt to identify the extent and scope of the fire services involvement in spinal injury management a survey of all fire services in Ireland was undertaken by PHECC. As Dublin Fire Brigade is directly involved in the provision of an ambulance service and is a PHECC licensed CPG provider they were excluded from the survey. A total of 26 (93%) responses to the survey were received.

The survey was divided into five specific areas, Service type, Equipment carried, Training, Clinical oversight and Operations, to get an overview of the entire operation of spinal injury management.

Spinal injury

Extrapolation from a six-month retrospective spinal injury study (unpublished) in one emergency department in 2015, estimate that approximately 850 patients receive clinically significant injuries to the spinal column per annum in Ireland. Clinically significant injuries are defined as an injury requiring bracing, a halo or surgical fixation. The National Spinal Injury Unit admitted 240 cases (62 with spinal cord injury) in 2014 (Mr Morris, Orthopaedic Surgeon, National Spinal Injury Unit).

At the seminar, Mr Morris stated that ‘for neurological injury to occur in conjunction with spinal column injury a significant trauma has to be applied’. He also advised that special consideration must be given for injury in patients with ankylosing spondylitis.

Studies have identified a conservative approach to immobilisation of potential spinal injuries in many incidences where the mechanism of injury is minimal and/or the clinical presentation would suggest it was not necessary. The NICE spinal injury guidelines (NICE 2016) have referred to use of a risk tool as a selective approach and only immobilising people where a concern is identified following assessment i.e. ‘spinal injury rule in’.

In a systematic review of pre-hospital spinal injury management carried out by Ahn et al one of the questions posed was the role for pre-hospital care providers in cervical spine clearance and immobilisation. The findings from the review were that practitioners can be trained to identify criteria for spinal injury clearance and provide appropriate care when a spinal injury is suspected.

“Emergency medical personnel in the pre-hospital setting can be trained to apply criteria to clear patients of cervical spinal injuries and immobilize patients suspected of having a cervical spinal injury” (Ahn, Singh et al. 2011)

Oteir et al similarly identify in their systematic review of the literature that there was little evidence regarding the relationship between prehospital spinal immobilization and patient neurological outcomes. (Oteir, Smith et al. 2014).

Recommendations

Practitioners at Paramedic and Advanced Paramedic level

Recommendation 1

Change terminology from 'spinal immobilisation' to 'spinal motion restriction' when referring to the management of pre-hospital spinal injuries.

The aim of this recommendation is to instigate a change of culture and allow practitioners to consider alternative methods of patient extrication and packaging.

Recommendation 2

Following trauma should any of the following factors be present:

- dangerous mechanism of injury
- fall from a height of greater than 1 metre or 5 steps
- axial load to the head or base of the spine – for example diving, high-speed motor vehicle collision, rollover motor accident, ejection from a motor vehicle, accident involving motorised recreational vehicle, bicycle collision, horse riding accident, pedestrian v vehicle
- Impaired awareness (alcohol/drug intoxication, confused/uncooperative or ALoC)
- age 65 years or older, with any of the above
- age 2 years or younger incapable of verbal communication, with any of the above the patient should be regarded as 'high risk' and have active spinal motion restriction applied until assessment is complete

There are two aims to this recommendation: the first is to ensure that 'high risk' patients minimise movement until a detailed assessment occurs: the second allows an informed decision about the most appropriate method of patient extrication and packaging, even though the patient has initially presented as 'high risk'.

Recommendation 3

Following trauma, if no 'high risk' factors are present, and where any two or more of the following factors are present:

- involved in a minor rear-end motor vehicle collision
- comfortable in a sitting position
- ambulatory at any time since the injury
- no midline cervical spine tenderness
- no spinal column/midline pain

and are able to actively rotate their neck 45 degrees to the left and right, the patient should be regarded as 'low risk' and have passive spinal motion restriction applied until assessment is complete.

The aim of this recommendation is to ensure that practitioners are confident to permit 'low risk' patients to self-splint or have passive support until a detailed assessment enables an informed decision in relation to the most appropriate method of patient extrication and packaging.

Recommendation 4

Following a trauma assessment, should a patient present with any of the following 'spinal injury rule in' considerations:

- any significant distracting injuries
- impaired awareness (alcohol/drug intoxication, confused/uncooperative or ALoC)
- immediate onset of spinal/midline back pain
- hand or foot weakness (motor issue)
- altered or absent sensation in the hands or feet (sensory issue)
- priapism
- history of past spinal problems, including previous spinal surgery or conditions that predispose to instability of the spine
- unable to actively rotate their neck 45 degrees to the left and right (P & AP only)

or an appropriate assessment cannot be completed, a 'spinal injury rule in' shall apply.

Active spinal motion restriction shall thereafter be implemented until arrival at ED.

The aims of recommendation 4 are to identify the 'spinal injury rule in' considerations for active spinal motion restriction and to increase awareness that appropriate patient assessment may not be feasible in all circumstances when making the decision on spinal motion restriction.

Recommendation 5

Uncooperative patients shall not be forced into active spinal motion restriction as this is a greater risk to the patient.

The aim of recommendation 5 is to ensure that additional unnecessary motion is not applied to a potentially unstable injury through forced spinal motion restriction.

Recommendation 6

There is no requirement to carry out or maintain active or passive spinal motion restriction following trauma if patients:

- are deemed to have minimal risk factors
- do not present with any of the 'spinal injury rule in' considerations
- are pain free and are able to actively rotate their neck 45 degrees left and right

The aim of recommendation 6 is to enable practitioners be confident to exclude a potential spinal injury for patients with 'minimal risk' and without 'spinal injury rule in' considerations.

Recommendation 7

If a decision is made, after the primary survey is complete and significant injuries stabilised, to continue active spinal motion restriction, a rigid cervical collar may be considered at this point prior to lifting/moving the patient.

The aim of recommendation 7 is to ensure that "high risk" patients and "low risk" patients with 'spinal injury rule in' considerations present have minimised cervical spine movement during initial assessment and that cervical collar application is a secondary process.

Recommendation 8

If mechanism of injury suggests a possible isolated lumbar or thoracic injury without cervical injury involved, cervical motion restriction is not indicated.

The aim of recommendation 8 is to remove the requirement for practitioners to apply cervical motion restriction for isolated thoracic or lumbar trauma.

Recommendation 9

Patients with 'high' or 'low risk' factors and in the absence of 'spinal injury rule in' considerations may be requested to self-extricate from a vehicle and be instructed to lie down on a trolley stretcher in a position of comfort.

For patients not meeting these criteria use active spinal motion restriction practice for extrication.

The aim of recommendation 9 is to permit practitioners to implement self-extrication techniques for 'high risk' and 'low risk' patients who present without 'spinal injury rule in' considerations.

Recommendation 10

If a patient with a suspected spinal injury is ambulatory following trauma, request the patient lies down on the trolley stretcher if he/she is able to do so. If unable to comply consider alternative methods.

The aim of recommendation 10 is to remove 'standing take down' as the standard of care for ambulatory patients.

Recommendation 11

Supine patients with suspected spinal injuries, where active spinal motion restriction is being continued, should be lifted with a split device in preference to a log roll.

The aim of recommendation 11 is to minimise unnecessary patient movement, particularly on multisystem trauma/pelvic injury patients to avoid clot disruption, for packaging.

Recommendation 12

A long board is primarily an extrication device and should be used primarily for this purpose.

The aim of recommendation 12 is to minimise secondary injury and discomfort for patients by strongly discouraging the practice of transport on long board.

Recommendation 13

The preferred mode for the transport of a patient with active spinal motion restriction is on a vacuum mattress. It is acknowledged that other devices may be utilised.

The aim of recommendation 13 is, following international evidence, to promote the use of vacuum mattress as the preferred option for transport of patients with query spinal injury.

Recommendation 14

Patients presenting with penetrating trauma and without neurological signs should not have spinal motion restriction applied. Rapid transport to ED is essential to reduce mortality.

The aim of recommendation 14 is to minimise on-scene times for treatment and packaging of penetrating trauma patients.

Recommendation 15

For patients with non-standard spinal anatomy e.g. ankylosing spondylitis, permit them to find a position where they are comfortable with manual spinal motion restriction. Non-standard methods such as rolled blankets may be utilised to accomplish spinal motion restriction.

The aim of recommendation 15 is to enable practitioners to use their judgement to package the patient appropriately for the patient's individual needs and particularly to reduce the incidence of inappropriate use of rigid cervical collars and other spinal injury devices on patients with non-standard spinal anatomy.

Recommendation 16

When possible, the highest PHECC registered practitioner level on-scene will determine if spinal motion restriction is to be used or discontinued i.e. cease active spinal motion restriction.

The aim of recommendation 16 is to enable practitioners to use their clinical judgement to discontinue active spinal motion restriction initiated by another practitioner or responder.

Recommendation 17

Paediatric patients following trauma should be assessed for spinal injury using the 'spinal injury rule' in considerations.

The aim of recommendation 17 is to enable the practitioner to assess and package the paediatric trauma patient using the adult criteria for spinal motion restriction. However, clinical judgement should err on the side of caution due to difficulties with assessment of paediatric trauma.

Recommendation 18

The preferred mode for the transport of a paediatric patient with active spinal motion restriction is on a vacuum mattress or appropriately sized vacuum device. It is acknowledged that other options may be used.

Non-standard methods such as rolled blankets may be utilised to accomplish spinal motion restriction.

The aim of recommendation 18 is to enable vacuum mattress be used as the primary option for spinal motion restriction for paediatric patients.

Recommendation 19

Uncooperative paediatric patients shall not be forced into active spinal motion restriction as this is a greater risk to the patient.

The aim of recommendation 19 is to ensure that distressed or uncooperative paediatric patients are supported in a position of comfort and not have forced active spinal motion restriction applied.

Recommendation 20

Very young conscious paediatric patients with suspected spinal injury may have spinal motion restriction applied using the child's own car seat if it is intact following a collision, however they should not be forced into this position.

The aim of recommendation 20 is to enable undamaged child car seats be used for spinal motion restriction for appropriately aged paediatric patients.

Recommendations

Practitioners at Emergency Medical Technician (EMT) level

Recommendation 21

EMTs shall provide active spinal motion restriction for all patients with 'high risk' or 'low risk' factors present even in the absence of any of the 'spinal injury rule in' considerations.

The aim of recommendation 21 is to differentiate the scope of practice between EMTs and other PHECC practitioners.

Recommendation 22

Recommendations 1, 2, 4, 5, 7, 10, 11, 12, 13, 14, 15, 17, 18, 19 and 20 shall apply to EMTs when managing suspected spinal injury.

The aim of recommendation 22 is to outline the scope of practice for EMTs when managing pre-hospital spinal injury.

Responders and spinal injury management

Recommendation 23

While waiting for the arrival of a practitioner, responders shall provide active spinal motion restriction for all patients if 'high risk' or 'low risk' factors are present.

The aim of recommendation 23 is to outline the rationale for responders in relation to spinal motion restriction.

Recommendation 24

Responders at FAR/OFA level should maintain the patient with suspected spinal injury in the position found while maintaining active spinal motion restriction.

The aim of recommendation 24 is to ensure that both 'high risk' and 'low risk' patients have minimised movement until a practitioner clinical assessment occurs.

Recommendation 25

Responders at EFR level should consider returning the head to neutral position (unless pain or resistance increases) and maintaining active spinal motion restriction if spinal injury is suspected.

The aim of recommendation 25 is to ensure that both 'high risk' and 'low risk' patients have minimised movement until a practitioner clinical assessment occurs.

Recommendation 26

Responders at EFR level, who are operating on behalf of a licensed CPG provider, may apply a cervical collar while maintaining active spinal motion restriction to facilitate extraction.

The aim of recommendation 26 is to ensure that responders extricating both 'high risk' and 'low risk' patients will be assisted to minimise movement during extrication. It is understood that in some circumstances rescue from inaccessible areas and vehicle extrication may occur prior to a thorough spinal assessment.

Recommendation 27

Responders at EFR level, who are operating on behalf of a licensed CPG provider, may extricate a patient on an appropriate device in the absence of a practitioner if:
(i) an unstable environment prohibits the attendance of a practitioner, or
(ii) while awaiting the arrival of a practitioner the patient requires rapid extrication to initiate emergency care

The aim of recommendation 27 is to authorise responders at EFR level to extricate patients with suspected spinal injury in the absence of a practitioner.

Recommendation 28

Responders at EFR level, who are operating on behalf of a licensed CPG provider, if waiting for an ambulance response may remove an extricated patient from an extrication device and secure into a transport device.

The aim of recommendation 28 is to enable the responder at EFR level to appropriately package a patient while awaiting ambulance transport to minimise discomfort/secondary injury and reduce on-scene time.

Recommendation 29

Responders at EFR level, who are operating on behalf of a licensed CPG provider may request a patient with a suspected spinal injury, who is ambulatory following trauma, to lie down on a trolley stretcher or other device if he/she is able to do so. If unable to comply consider alternative methods.

The aim of recommendation 29 is to remove 'standing take down' as the standard of care for ambulatory patients.

Recommendation 30

Responders at EFR level, who are operating on behalf of a licensed CPG provider following the provision of spinal injury management, shall complete an Ambulatory Care Report (ACR) or Patient Care Report (PCR) and present the top copy to the practitioner transporting the patient to ED.

The aim of recommendation 30 is to ensure that all clinical interventions are documented and become part of the patient care record.

Recommendation 31

Recommendations 1, 2, 4, 5, 11, 12, 14, 15, 17, 19 and 20 shall apply to EFRs operating on behalf of a licensed CPG provider when managing suspected spinal injury.

The aim of recommendation 31 is to outline the scope of practice for EFRs when managing pre-hospital spinal injury.

Literature review

The Centre for Prehospital Research (C.P.R.) at the University of Limerick (UL) was tasked to complete a systematic literature review on pre-hospital spinal injury management the results of which were presented at the seminar. C.P.R. reported that in order to reduce potential bias they did not report on the extrication research published by UL in 2015. This specific research was presented at the seminar however.

“Spinal immobilisation in pre-hospital and emergency care; a systematic review of the literature” Hood and Considine (2015): A synopsis review.

“In February 2015, Hood & Considine conducted a systematic literature review of English language publications from 1966 to February 2015 indexed in MEDLINE and Cochrane Library. Scopus and Google Scholar were also searched. The combined searches yielded 2,470 studies that were assessed for inclusion as evidence. Studies examining the effectiveness of spinal immobilisation in the emergency care of suspected traumatic spinal injuries and studies of the patients with suspected spinal injuries or studies of healthy human volunteers were included in the review” (Hood & Considine, 2015 p. 120). A summary of the search results was presented in table format:

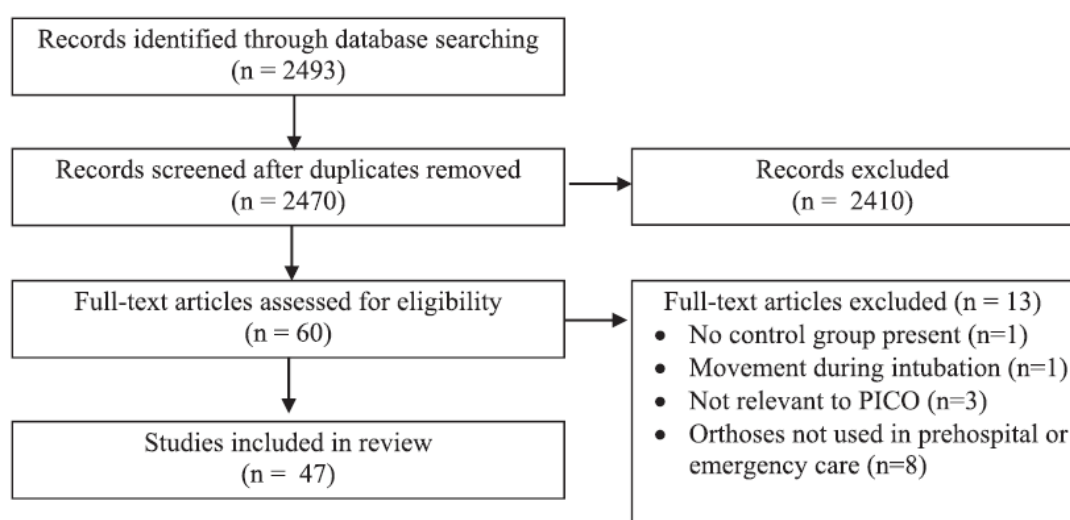


Figure 1 Summary of search results.

Source: Hood & Considine (2015)

Aim

The aim of the systematic review was to examine the evidence related to spinal immobilisation in pre-hospital and emergency care settings. Specifically, Hood & Considine (2015) sought to answer the question: “*In victims with suspected spinal injury, does the use of spinal immobilisation during pre-hospital or emergency care (in-line manual immobilisation, head blocks, spinal boards, cervical collars), compared with no immobilisation, effect neurological outcome or other outcomes (prevention of movement, spinal positioning/alignment, comfort or pain, and complications)?*” (Hood & Considine, 2015).

The outcomes of interest were:

- A. Neurological Outcome
- B. Prevention of Movement
- C. Spinal Positioning/Alignment
- D. Comfort or pain
- E. Complications

Results

“There were 47 studies meeting inclusion criteria for further review. Ten studies were case series (LOE 1V) and there were 37 studies from which data were extrapolated from healthy volunteers, cadavers or multiple trauma patients; extrapolated data does not have a level of evidence. There were 15 studies that were supportive of spinal immobilisation, 13 studies neutral for spinal immobilisation and 19 studies opposing spinal immobilisation” (Hood & Considine, 2015).

A. Effect of spinal immobilisation on neurological outcome

There were eight studies that examined the effect of spinal immobilisation on neurological outcome.

Findings:

One study of patients with **penetrating trauma** opposed spinal immobilisation. Reporting that the in-hospital mortality of spinal immobilized patients was more than double that of those who were not immobilized (Hood & Considine, 2015).

- (i) Haut ER, Kalish BT, Efron DT, Haider AH, Stevens KA, Kieninger AN, et al. Spine immobilization in penetrating trauma: more harm than good? *J Trauma* 2010;**68**:115—20 [discussion 20-1].

Two studies of patients with **torso gunshot wounds (GSW)** showed that few patients have an unstable spinal injury without complete spinal cord injury and thereby argued that spinal immobilisation was not of any actual or potential benefit (Hood & Considine, 2015). Brown et al., argued that 40.6% of patients with torso GSW required emergent endotracheal intubation and 54.5% required emergency surgical intervention so pre-hospital spinal immobilisation in these patients also carried a risk of interfering with emergent care (cited in Hood & Considine (2015) p125).

- (i) Brown JB, Bankey PE, Sangosanya AT, Cheng JD, Stassen NA, Gestring ML. Prehospital spinal immobilization does not appear to be beneficial and may complicate care following gunshot injury to the torso. *J Trauma Acute Care Surg* 2009;**67**:774—8.
- (ii) Cornwell EE, Chang DC, Bonar JP, Campbell KA, Phillips J, Lipsett P, et al. Thoracolumbar immobilization for trauma patients with torso gunshot wounds: is it necessary? *Arch Surg* 2001;**136**:324—7.

Two studies of patients with **penetrating neck injuries** raised issues of risk benefit ratio; both authors concluded that in hazardous environments the risk benefit ratio of mandatory spinal immobilisation was unfavourable (Hood & Considine, 2015).

- (i) Arishita GI, Vayer JS, Bellamy RF. Cervical spine immobilization of penetrating neck wounds in a hostile environment. *J Trauma* 1989;**29**:332—7.
- (ii) Ramasamy A, Midwinter M, Mahoney P, Clasper J. Learning the lessons from conflict: pre-hospital cervical spine stabilisation following ballistic neck trauma. *Injury* 2009;**40**:1342—5.

“In patients **suffering from blunt spinal trauma** Hauswald et al., reported that spinal immobilisation had a less than 2% chance of having a beneficial effect in terms of neurological outcome” (Hood & Considine, 2015).

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

“In Patients who had **suffered motorcycle accidents** Lin et al., observed that the incidence of cervical spine injury was low (0.7%), that injuries often involve more than two vertebrae and that most cervical spine injuries presented as stable” (Hood & Considine, 2015).

- (ii) Lin H-L, Lee W-C, Chen C-W, Lin T-Y, Cheng Y-C, Yeh Y-S, et al. Neck collar used in treatment of victims of urban motorcycle accidents: over-or under protection? *Am J Emerg Med* 2011;**29**:1028—33.

While Flabouris et al., (2001) highlighted the diagnostic challenge of identifying which patients require spinal immobilisation in the field, reporting a 31% diagnostic accuracy rate among medical teams in identifying patients with spinal injury (Hood & Considine, 2015).

- (i) Flabouris A. Clinical features patterns of referral and out of hospital transport events for patients with suspected isolated spinal injury. *Injury* 2001;**32**:569—75.

B. Effect of spinal immobilisation on preventing movement

Sixteen studies examined the effect of spinal immobilisation on preventing movement.

Findings:

Ten studies were supportive of spinal immobilisation decreasing movement.

- (i) Huerta C, Griffith R, Joyce SM. Cervical spine stabilization in paediatric patients: evaluation of current techniques. *Ann Emerg Med* 1987;**16**:1121—6.
- (ii) Cline JR, Scheidel E, Bigsby EF. A comparison of methods of cervical immobilization used in patient extrication and transport. *J Trauma* 1985;649—53.
- (iii) Graziano AF, Scheidel EA, Cline JR, Baer LJ. A radiographic comparison of prehospital cervical immobilization methods. *Ann Emerg Med* 1987;**16**:1127—31.
- (iv) Krell JM, McCoy MS, Sparto PJ, Fisher GL, Stoy WA, Hostler DP. Comparison of the Ferno Scoop Stretcher with the longback board for spinal immobilization. *Prehosp Emerg Care* 2006;**10**:46—51.
- (v) Boissy P, Shrier I, Brière S, Mellette J, Fecteau L, Matheson GO, et al. Effectiveness of cervical spine stabilization techniques. *Clin J Sport Med* 2011;**21**:80—8.
- (vi) Mazolewski P, Manix TH. The effectiveness of strapping techniques in spinal immobilization. *Ann Emerg Med* 1994;**23**:1290—5.
- (vii) Podolsky S, Baraff LJ, Simon RR, Hoffman JR, Larmon B, Ablon W. Efficacy of cervical spine immobilization methods. *J Trauma* 1983;**23**:461—5.
- (viii) Rosen PB, McSwain Jr NE, Arata M, Stahl S, Mercer D. Comparison of two new immobilization collars. *Ann Emerg Med* 1992;**21**:1189—95.32.
- (ix) Burl MM. Effectiveness of cervical collars in limiting movement. *Physiotherapy* 1991;**77**:308—10.
- (x) Engsberg JR, Standeven JW, Shurtleff TL, Eggars JL, Shafer JS, Naunheim RS. Cervical spine motion during extrication. *J Emerg Med* 2013;**44**:122—7.

Four studies were neutral, reporting that immobilisation had no effect on movement when compared to no immobilisation.

- (i) Conrad BP, Rehtine G, Weight M, Clarke J, Horodyski M. Motion in the unstable cervical spine during hospital bed transfers. *J Trauma* 2010;**69**:432—6.
- (ii) Del Rossi G, Heffernan TP, Horodyski M, Rehtine GR. The effectiveness of extrication collars tested during the execution of spine-board transfer techniques. *Spine J* 2004;**4**:619—23.
- (iii) Perry SD, McLellan B, McIlroy WE, Maki BE, Schwartz M, Fernie GR. The efficacy of head immobilization techniques during simulated vehicle motion. *Spine* 1999;**24**:1839.
- (iv) Horodyski M, DiPaola CP, Conrad BP, Rehtine GR. Cervical collars are insufficient for immobilizing an unstable cervical spine injury. *J Emerg Med* 2011;**41**:513—9.

One study produced conflicting results with increases in some movements and decreases in others.

- (i) Hamilton RS, Pons PT. The efficacy and comfort of full-body vacuum splints for cervical-spine immobilization. *J Emerg Med* 1996;**14**:553—9.

One study opposed spinal immobilisation reporting increased separation between C1 and C2 when spinal immobilisation was in place.

- (i) Ben-Galim P, Dreiangel N, Mattox KL, Reitman CA, Kalantar SB, Hipp JA. Extrication collars can result in abnormal separation between vertebrae in the presence of a dissociative injury. *J Trauma* 2010;**69**:447—50.

C. Effect of spinal immobilisation on optimal spinal positioning

According to Hood & Considine (2015) five studies examined the effect of spinal immobilisation on optimal spinal positioning or alignment they found that all were of poor methodological quality and all were supportive of the use of spinal immobilisation to optimize spinal alignment.

- (i) De Lorenzo RA, Olson JE, Boska M, Johnston R, Hamilton GC, Augustine J. Optimal positioning for cervical immobilization. *Ann Emerg Med* 1996;**28**:301—8.
- (ii) Nypaver M, Treloar D. Neutral cervical spine positioning in children. *Ann Emerg Med* 1994;**23**:208—11.
- (iii) Schriger DL, Larmon B, LeGassick T, Blinman T. Spinal immobilization on a flat backboard: does it result in neutral position of the cervical spine? *Ann Emerg Med* 1991;**20**:878—81.
- (iv) Gunn BD, Eizenberg N, Silberstein MS, McMeeken JM, Tully EA, Stillman BC, et al. How should an unconscious person with a suspected neck injury be positioned? *Prehosp Disaster Med* 1995;**10**:239—44.
- (v) Treloar DJ, Nypaver M. Angulation of the paediatric cervical spine with and without cervical collar. *Pediatr Emerg Care* 1997;**13**:5—8.

D. Effect of spinal immobilisation on decreasing pain or improving comfort

There were five studies that examined the effect of spinal immobilisation on decreasing pain or improving comfort; all opposed the use of spinal immobilisation to decrease pain or improve comfort.

- (i) Cordell WH, Olinger ML, Stroman SJ, Nelson DR. Pain and tissue-interface pressures during spine-board immobilisation. *Ann Emerg Med* 1995;**26**:31—6.
- (ii) Hauswald M, Hsu M, Stockoff C. Maximizing comfort and minimizing ischemia: a comparison of four methods of spinal immobilization. *Prehosp Emerg Care* 2000;**4**:250—2.
- (iii) Lerner EB, Billittier AJ, Moscati RM. The effects of neutral positioning with and without padding on spinal immobilization of healthy subjects. *Prehosp Emerg Care* 1998;**2**:112—6.
- (iv) Walton R, DeSalvo JF, Ernst AA, Shahane A. Padded vs unpadded spine board for cervical spine immobilization. *Acad Emerg Med* 1995;**2**:725—8.
- (v) Chan D, Goldberg RM, Mason J, Chan L. Backboard versus mattress splint immobilization: a comparison of symptoms generated. *J Emerg Med* 1996;**14**:293—8.

E. Complications caused by spinal immobilisation

There were thirteen studies that examined complications caused by spinal immobilisation.

Six studies found that cervical collars caused a **significant increase in intracranial pressure**.

- (i) Davies G, Deakin C, Wilson A. The effect of a rigid collar on intracranial pressure. *Injury* 1996;**27**:647—9.

- (ii) Kolb JC, Summers RL, Galli RL. Cervical collar-induced changes in intracranial pressure. *Am J Emerg Med* 1999;**17**:135—7.
- (iii) Mobbs RJ, Stoodley MA, Fuller J. Effect of cervical hard collar on intracranial pressure after head injury. *Aust N Z J Surg* 2002;**72**:389—91.
- (iv) Raphael J, Chotai R. Effects of the cervical collar on cerebrospinal fluid pressure. *Anaesthesia* 1994;**49**:437—9.
- (v) Hunt K, Hallworth S, Smith M. The effects of rigid collar placement on intracranial and cerebral perfusion pressures. *Anaesthesia* 2001;**56**:511—3.
- (vi) Stone MB, Tubridy CM, Curran R. The effect of rigid cervical collars on internal jugular vein dimensions. *Acad Emerg Med* 2010;**17**:100—2.

Two studies reported **respiratory complications**.

One study reported that spinal immobilisation using backboard **decreased forced vital capacity (FVC) in children**.

- (i) Schafermeyer RW, Ribbeck BM, Gaskins J, Thomason S, Harlan M, Attkisson A. Respiratory effects of spinal immobilization in children. *Ann Emerg Med* 1991;**20**:1017—9.

The other study of adult volunteers showed that both wooden backboards and vacuum mattresses **restricted respiration**.

- (ii) Totten VY, Sugarman DB. Respiratory effects of spinal immobilization. *Prehosp Emerg Care* 1999;**3**:347—52.

Two studies showed **increased tissue-device interface pressures** with spinal immobilisation.

- (iii) Main P, Lovell M. A review of seven support surfaces with emphasis on their protection of the spine. *J Acad Emerg Med* 1996;**13**:34—7.
- (iv) Sheerin F, de Frein R. The occipital and sacral pressures experienced by healthy volunteers under spinal immobilization: a trial of three surfaces. *J Emerg Nurs* 2007;**33**:447—50.

One case study publication also showing **significant pressure ulceration** from spinal immobilisation in two patients

- (i) Liew S, Hill D. Complication of hard cervical collars in multi-trauma patients. *Aust N Z J Surg* 1994;**64**:139—40.

One case study reported **dysphagia** caused by hard cervical collar in a patient with cervical myelopathy secondary to rheumatoid arthritis.

- (ii) Houghton D, Curley J. Dysphagia caused by a hard cervical collar. *Br J Neurosurg* 1996; **10**:501—2.

One study that was neutral for the effect of cervical spine immobilisation on tidal volume; Dodd et al., (1995) concluded that cervical collars made no statistically significant difference to tidal volume and that a correctly fitting cervical collar had no significant effect on airway patency.

- (iii) Dodd F, Simon E, McKeown D, Patrick M. The effect of a cervical collar on the tidal volume of anaesthetised adult patients. *Anaesthesia* 1995;**50**:961—3.

Conclusion

There are no published high-level studies that assess the efficacy of spinal immobilisation in the pre-hospital and emergency care settings. Almost all of the current evidence related to spinal immobilisation is extrapolated data, mostly from healthy volunteers. There were no studies that showed spinal immobilisation improved neurological outcomes as all studies using neurological outcome as an endpoint were neutral due to high mortality rates from other causes (mostly gunshot wounds). Based on the current evidence it appears immobilisation does prevent movement but the clinical significance of movement prevention is unknown. Spinal immobilisation has a high risk of complications and cervical collars may mask other injuries and delay diagnosis and definitive care. Protocols that recommend application of spinal immobilisation should consider the risk vs benefits. Prospective studies of patients at risk of, or with actual spinal injuries, are needed using real pre-hospital or clinical environments.

Practitioners at Paramedic and Advanced Paramedic level

Question 1: What is the most appropriate terminology associated with pre-hospital spinal injury management?

Immobile is defined as '*not able to move or be moved*' (Collins English Dictionary, 1987). Current pre-hospital spinal injury management practice refers to 'spinal immobilisation' which gives the false impression that the spinal column is fully immobilised when utilising the current equipment available for this practice. A 2003 study compares different spinal injury management devices use degrees of patient movements to grade devices. This studies identify that some movement occurs with all devices. (Luscombe and Williams 2003). This clearly demonstrates that the current devices do not 'immobilise' patients. Similarly, a common perception is that a cervical collar immobilises the cervical spine although it is designed only to limit flexion. Using the term immobilisation instils false confidence that the patient is 'packaged' appropriately and that all patients suspected with a spinal injury must be so packaged.

The requirements are in fact to restrict movement to reduce the probability of secondary insult and not to add to the patient's pain and discomfort by trying to lock them down on a device. The preferred term is 'spinal motion restriction' as it reflects the process and the desired outcome (Morrissey, Kusel et al. 2014).

Spinal motion restriction includes reduction of gross movement by the patient and prevention of duplicating the damaging mechanism to the spine. Several patient packaging methods can be utilised along with regular reassessment of motor and sensory function. Research has shown that many traditional forms of patient packaging can increase symptoms without contributing benefit (Chan, Goldberg et al. 1996).

Recommendation 1

Change terminology from 'spinal immobilisation' to 'spinal motion restriction' when referring to the management of pre-hospital spinal injuries.

The aim of this recommendation is to instigate a change of culture and allow practitioners to consider alternative methods of patient extrication and packaging.

Developments in pre-hospital spinal injury management have identified that not all trauma patients require full spinal motion restriction using devices to achieve this objective. Patients with 'low risk' of spinal injury following trauma in particular do not require active motion restriction using devices. This will be outlined in more detail below.

'Active spinal motion restriction' is defined as using manual inline techniques with or without spinal injury management devices to reduce spinal column motion.

'Passive spinal motion restriction' is defined as requesting the patient to minimise his/her movement without external intervention and permitting the patient to lie on a trolley stretcher in a position of comfort.

'Distracting injury'-A distracting injury is something so painful that the patient cannot pay attention to other injuries, they feel nothing but the distractor; see Appendix 2 for more detail.

Question 2: What are the initial risk assessments suggestive of spinal injury?

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016 (NICE 2016)

9. Assess whether the person is at high, low or no risk for cervical spine injury using the Canadian C-spine rule as follows:

- the person is at 'high risk' if they have at least one of the following high-risk factors:
 - age 65 years or older
 - dangerous mechanism of injury (fall from a height of greater than 1 metre or 5 steps, axial load to the head – for example diving, high-speed motor vehicle collision, rollover motor accident, ejection from a motor vehicle, accident involving motorised recreational vehicles, bicycle collision, horse riding accidents)
 - paraesthesia in the upper or lower limbs
- the person is at 'low risk' if they have at least one of the following low-risk factors:
 - involved in a minor rear-end motor vehicle collision
 - comfortable in a sitting position
 - ambulatory at any time since the injury
 - no midline cervical spine tenderness
 - delayed onset of neck pain
 - the person remains at 'low risk' if they are:
 - unable to actively rotate their neck 45 degrees to the left and right (the range of the neck can only be assessed safely if the person is at 'low risk' and there are no high-risk factors)
- the person has no risk if they:
 - have one of the above low-risk factors and
 - are able to actively rotate their neck 45 degrees to the left and right

If a patient is presenting with a spinal injury or the practitioner suspects a spinal injury this will impact on the management of the patient.

Patients with '**high risk**' factors should be regarded as having a spinal injury until assessment indicates otherwise and active spinal motion restriction applied until a decision is made to continue with spinal motion restriction or not.

Patients with '**low risk**' factors should be regarded as having a low probability of spinal injury until assessment indicates otherwise and passive spinal motion restriction (advise patient to remain still) applied until a decision is made to continue with spinal motion restriction or not.

Patients with '**minimal risk**' factors should be regarded as having no spinal injury unless assessment indicates otherwise and no spinal motion restriction applied.

Mechanism of injury should raise the index of suspicion and should alert the practitioner/responder to the possibility of injury. It should however not dictate the clinical care provided. Care must be decided primarily on the clinical findings.

Recommendation 2

Following trauma should any of the following factors be present:

- dangerous mechanism of injury
- fall from a height of greater than 1 metre or 5 steps
- axial load to the head or base of the spine – for example diving, high-speed motor vehicle collision, rollover motor accident, ejection from a motor vehicle, accident involving motorised recreational vehicle, bicycle collision, horse riding accident, pedestrian v vehicle
- Impaired awareness (alcohol/drug intoxication, confused/uncooperative or ALoC)
- age 65 years or older, with any of the above
- age 2 years or younger incapable of verbal communication, with any of the above the patient should be regarded as 'high risk' and have active spinal motion restriction applied until assessment is complete

There are two aims to this recommendation: the first is to ensure that 'high risk' patients minimise movement until a detailed assessment occurs: the second allows an informed decision about the most appropriate method of patient extrication and packaging even though the patient has initially presented as 'high risk'.

Recommendation 3

Following trauma, if no 'high risk' factors are present, and where any two or more of the following factors are present:

- involved in a minor rear-end motor vehicle collision
- comfortable in a sitting position
- ambulatory at any time since the injury
- no midline cervical spine tenderness
- no spinal column/midline pain

and are able to actively rotate their neck 45 degrees to the left and right, the patient should be regarded as 'low risk' and have passive spinal motion restriction applied until assessment is complete

The aim of this recommendation is to ensure that practitioners are confident to permit 'low risk' patients to self-splint or have passive support until a detailed assessment enables an informed decision in relation to the most appropriate method of patient extrication and packaging.

Question 3: What will indicate continuation of spinal motion restriction following an initial risk assessment?

PHECC survey

Survey statement: *That trauma patients for whom immobilisation on a backboard is not necessary include those with all of the following;*

- *Normal level of consciousness (GCS 15)*
- *No spine tenderness or anatomic abnormality*
- *No neurologic findings or complaints*
- *No distracting injury*
- *No intoxication*

A majority of respondents (56.6%) either disagreed or strongly disagreed with the statement. The converse is that a sizeable minority 39.5% agreed or strongly agreed with the statement. The balance (3.9%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is an overwhelming negative response to the statement from those that did not attend the seminar (88.6%) compare to those that did (0%) ($p = 0.447$). This is a trend throughout and may demonstrate the impact of the presenters and debate on those that attended the seminar.

		Seminar attended		Total
		Yes	No	
That trauma patients for whom immobilisation on a backboard is not necessary include those with all of the following;	Strongly disagree	0	57	57
	Disagree	0	29	29
	Neutral	0	6	6
	Agree	12	3	15
	Strongly agree	43	2	45
Total		55	97	152

Of the doctors surveyed 83.7% either strongly disagreed or disagreed with the statement compared to 45.8% of PHECC practitioners. Forty (90.9%) of doctors did not attend the seminar.

Position Statement: National Association of EMS Physicians and American College of Surgeons Committee on Trauma, 2014 (White, Domeier et al. 2014)

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*

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

3. Assess the person for spinal injury, initially taking into account the factors listed below.

Check if the person:

- *has any significant distracting injuries*
- *is under the influence of drugs or alcohol*
- *is confused or uncooperative*
- *has a reduced level of consciousness*
- *has any spinal pain*
- *has any hand or foot weakness (motor assessment)*
- *has altered or absent sensation in the hands or feet (sensory assessment)*
- *has priapism (unconscious or exposed male)*
- *has a history of past spinal problems, including previous spinal surgery or conditions that predispose to instability of the spine.*

4. Carry out full in-line spinal immobilisation if any of the factors in recommendation 3 are present or if this assessment cannot be done.

11. Assess the person with suspected thoracic or lumbosacral spine injury using these factors:

- age 65 years or older and reported pain in the thoracic or lumbosacral spine
- dangerous mechanism of injury (fall from a height of greater than 3 metres, axial load to the head or base of the spine – for example falls landing on feet or buttocks, high-speed motor vehicle collision, rollover motor accident, lap belt restraint only, ejection from a motor vehicle, accident involving motorised recreational vehicles, bicycle collision, horse riding accidents)
- pre-existing spinal pathology, or known or at risk of osteoporosis – for example steroid use
- suspected spinal fracture in another region of the spine
- abnormal neurological symptoms (paraesthesia or weakness or numbness)
- on examination:
 - abnormal neurological signs (motor or sensory deficit)
 - new deformity or bony midline tenderness (on palpation)
 - bony midline tenderness (on percussion)
 - midline or spinal pain (on coughing)
- on mobilisation (sit, stand, step, assess walking): pain or abnormal neurological symptoms (stop if this occurs).

13. Carry out or maintain full in-line spinal immobilisation if:

- a high-risk factor for cervical spine injury is identified and indicated by the Canadian C-spine rule
- a low-risk factor for cervical spine injury is identified and indicated by the Canadian C-spine rule and the person is unable to actively rotate their neck 45 degrees left and right
- if indicated by one or more of the factors listed in recommendation 11.

14. Do not carry out or maintain full in-line spinal immobilisation in people if:

- they have low-risk factors for cervical spine injury as identified and indicated by the Canadian C-spine rule, are pain free and are able to actively rotate their neck 45 degrees left and right
- they do not have any of the factors listed in recommendation 11.

The five parameters for active spinal motion restriction used in the PHECC survey were those outlined in the position statement of the National Association of EMS Physicians and American College of Surgeons Committee on Trauma, 2012. The NICE 2016 guidelines, although listed as nine parameters when the ones referring to impaired awareness (three) are combined, have a total of seven parameters. The NICE guidelines will give a broader perspective than the initial survey question.

Recommendation 4

Following a trauma assessment, should a patient present with any of the following 'spinal injury rule in' considerations:

- any significant distracting injuries
- impaired awareness (alcohol/drug intoxication, confused/uncooperative or ALoC)
- immediate onset of spinal/midline back pain
- hand or foot weakness (motor issue)
- altered or absent sensation in the hands or feet (sensory issue)
- priapism
- history of past spinal problems, including previous spinal surgery or conditions that predispose to instability of the spine
- unable to actively rotate their neck 45 degrees to the left and right (P & AP only)

or an appropriate assessment cannot be completed, a 'spinal injury rule in' shall apply.

Active spinal motion restriction shall thereafter be implemented until arrival at ED.

The aims of recommendation 4 are to identify the 'spinal injury rule in' considerations for active spinal motion restriction and to increase awareness that appropriate patient assessment may not be feasible in all circumstances when making the decision on spinal motion restriction.

Recommendation 5

Uncooperative patients shall not be forced into active spinal motion restriction as this is a greater risk to the patient.

The aim of recommendation 5 is to ensure that additional unnecessary motion is not applied to a potentially unstable injury through forced spinal motion restriction.

Recommendation 6

There is no requirement to carry out or maintain active or passive spinal motion restriction following trauma if patients:

- are deemed to have minimal risk factors
- do not present with any of the 'spinal injury rule in' considerations
- are pain free and are able to actively rotate their neck 45 degrees left and right

The aim of recommendation 6 is to enable practitioners be confident to exclude a potential spinal injury for patients with 'minimal risk' and without 'spinal injury rule in' considerations.

Paramedic and Advanced Paramedic level	Mechanism of injury	
	High Risk	Low Risk
'Spinal rule in' considerations	Active SMR	Active SMR
No 'spinal rule in' considerations	Passive SMR	Passive SMR

Question 4: If spinal motion restriction criteria are met should a cervical collar be applied and if so when?

PHECC survey

Survey statement: *That the 'c' in the trauma primary survey, AcBC, means that the cervical spine is protected and that a cervical collar should be applied during the primary survey or before significant injuries are managed.*

The majority of respondents (60.9%) either disagreed or strongly disagreed with the statement. The converse is that a sizeable minority 31.7% agreed or strongly agreed with the statement. The balance (7.4%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a sizeable negative response to the statement from both cohorts respectively (88.7% & 45.9%). It is noted that 21.9% of those that did not attend the seminar were neutral with their response, this again may highlight the strength of the debate at the seminar.

		Seminar attended		Total
		Yes	No	
That the 'c' in the trauma primary survey, AcBC, means that the cervical spine is protected and that a cervical collar should be applied during the primary survey or before significant injuries are managed	Strongly disagree	28	14	42
	Disagree	19	31	50
	Neutral	3	8	11
	Agree	3	33	36
	Strongly agree	0	12	12
Total		53	98	151

Position Statement: National Association of EMS Physicians and American College of Surgeons Committee on Trauma, 2014

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.

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

1. On arrival at the scene of the incident, use a prioritising sequence to assess people with suspected trauma, for example CABCDE
2. At all stages of the assessment:
 - protect the person's cervical spine with manual in-line spinal immobilisation, particularly during any airway intervention and
 - avoid moving the remainder of the spine
3. Assess the person for spinal injury, initially taking into account the factors listed below (list provided)

4. *Carry out full in-line spinal immobilisation if any of the factors in recommendation 3 are present or if this assessment cannot be done*

21. *When carrying out full in-line spinal immobilisation in adults, manually stabilise the head with the spine in-line using the following stepwise approach:*

- *Fit an appropriately sized semi-rigid collar unless contraindicated by:*
 - *a compromised airway*
 - *known spinal deformities, such as ankylosing spondylitis (in these cases keep the spine in the person's current position)*
- *Reassess the airway after applying the collar*

The National Association of EMS Physicians and American College of Surgeons Committee on Trauma are silent on when a cervical collar should be applied in the process of pre-hospital spinal injury management. The NICE 2016 guidelines however are clear that an ABCDE assessment while maintaining manual spinal motion restriction is the appropriate sequence. When neutral respondents to the PHECC survey are excluded the majority of respondents (65.7%) also concurred with the NICE position and favour a cervical collar application after the primary survey is completed.

Recommendation 7

If a decision is made, after the primary survey is complete and significant injuries stabilised, to continue active spinal motion restriction, a rigid cervical collar may be considered at this point prior to lifting/moving the patient.

The aim of recommendation 7 is to ensure that "high risk" patients and "low risk" patients with 'spinal injury rule in' considerations present have minimised cervical spine movement during initial assessment and that cervical collar application is a secondary process.

Recommendation 8

If mechanism of injury suggests a possible isolated lumbar or thoracic injury without cervical injury involved, cervical motion restriction is not indicated.

The aim of recommendation 8 is to remove the requirement for practitioners to apply cervical motion restriction for isolated thoracic or lumbar trauma.

Question 5: Should self-extrication be utilised for patients with 'low risk' of spinal injury involved in an RTC?

PHECC survey

Survey statement: *That stable patients should be asked to step out of the crashed car and not extricated with equipment.*

The respondents are split exactly (44.3%) between agreement and disagreement on this statement.

The balance (11.3%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a significant negative response to the statement from those that did not attend the seminar (66.7%) compared to those that did (5.8%). ($p = 0.0$) This demonstrate the influence of the seminar debate.

		Attended Seminar		Total
		Yes	No	
That stable patients should be asked to step out of the crashed car and not extricated with equipment	Strongly disagree	2	29	31
	Disagree	1	35	36
	Neutral	4	13	17
	Agree	21	10	31
	Strongly agree	27	9	36
Total		55	96	151

Confirmation of suboptimal protocols in spinal immobilisation, (Dixon, O'Halloran et al. 2015)

That for haemodynamically stable patients controlled self-extrication causes less movement of the cervical spine than extrications performed using traditional prehospital rescue equipment.

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

24. Consider asking a person to self-extricate if they are not physically trapped and have none of the following:

- significant distracting injuries
- abnormal neurological symptoms (paraesthesia or weakness or numbness)
- spinal pain
- high-risk factors for cervical spine injury as assessed by the Canadian C-spine rule

25. Explain to a person who is self-extricating that if they develop any spinal pain, numbness, tingling or weakness, they should stop moving and wait to be moved.

26. When a person has self-extricated:

- ask them to lay supine on a stretcher positioned adjacent to the vehicle or incident

The comprehensive Irish study (Dixon, O'Halloran et al. 2015) funded by PHECC and the explicit support of the NICE 2016 guideline for self-extrication of patients with low risk and no risk the process for self-extrication appears to be the appropriate practice. When neutral respondents to the PHECC survey are excluded there is an equal number of respondents (50%) in favour of and against this position.

Recommendation 9

Patients with 'high' or 'low risk' factors and in the absence of 'spinal rule in' considerations may be requested to self-extricate from a vehicle and be instructed to lie down on a trolley stretcher in a position of comfort.
For patients not meeting these criteria, use active spinal motion restriction practice for extrication.

The aim of recommendation 9 is to permit practitioners to implement self-extrication techniques for 'high risk' and 'low risk' patients who present without 'spinal injury rule in' considerations.

Question 6: Should a 'standing take down' be utilised for ambulatory patients at a trauma scene?

PHECC survey

Survey statement: *That patients who are walking around following trauma should be asked to lie down directly on a trolley stretcher and not have a standing-take-down performed.*

A significant minority of respondents (46.4%) agreed or strongly agreed with the statement.

The converse is that a sizeable minority (37.7%) either disagreed or strongly disagreed with the statement.

The balance (15.9%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a more negative response to the statement from those that did not attend the seminar (55.1%) compared to those that did (5.7%). ($p = 0.0$) This demonstrates the strength of the arguments presented at the seminar.

		Seminar attended		Total
		Yes	No	
That patients who are walking around following trauma should be asked to lie down directly on the trolley stretcher and not have a standing-take-down performed	Strongly disagree	1	27	28
	Disagree	2	27	29
	Neutral	7	17	24
	Agree	14	19	33
	Strongly agree	29	8	37
Total		53	98	151

Position Statement: National Association of EMS Physicians and American College of Surgeons Committee on Trauma, 2014

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*

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

5. 'Standing take down' practice should be avoided.

It was also agreed that the practice of a 'standing take down' where a person who is wandering around with an element of neck ache gets placed against an upright spinal board and placed horizontal and then immobilised is seldom if ever warranted.

The NICE 2016 guidelines are silent on this issue. Similar to the self-extrication it is estimated that there will be less movement of the spinal column if the patient lies down him/her self on a trolley stretcher and not have a 'standing take down' performed. When neutral respondents to the PHECC survey are excluded there is a majority of respondents (55.1%) in favour of this position.

Recommendation 10

If a patient with a suspected spinal injury is ambulatory following trauma, request the patient lies down on the trolley stretcher if he/she is able to do so. If unable to comply, consider alternative methods.

The aim of recommendation 10 is to remove 'standing take down' as the standard of care for ambulatory patients.

Question 7: When lifting a supine patient with a suspected spinal injury is it preferable to use a split stretcher or a log roll onto a long board?

PHECC survey

Survey statement: *That supine patients with suspected spinal injury should be lifted with an orthopaedic (scoop) stretcher and not log rolled onto a long board.*

A sizeable minority of respondents 46.9% agreed or strongly agree with the statement.

The converse is that a sizeable minority (44.2%) also either disagreed or strongly disagreed with the statement. The balance (8.8%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a more negative response to the statement from those that did not attend the seminar (67%) compared to those that did (0%). ($p = 0.0$).

		Seminar attended		Total
		Yes	No	
That supine patients with suspected spinal injury should be lifted with an orthopaedic (scoop) stretcher and not log rolled onto a long board	Strongly disagree	0	31	31
	Disagree	0	34	34
	Neutral	0	13	13
	Agree	15	14	29
	Strongly agree	35	5	40
Total		50	97	147

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

21. When carrying out full in-line spinal immobilisation in adults, manually stabilise the head with the spine in-line using the following stepwise approach:

- Place and secure the person on a scoop stretcher.

27. Do not transport people with suspected spinal injury on a longboard or any other extrication device. A longboard should only be used as an extrication device.

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

1. The long spinal board is an extrication device solely.

With respect to methods of immobilisation, a firm distinction was made between extrication and transport/evacuation. The Faculty recommend the use of a long board solely as an extrication device and not for the transport of patients to hospital. For this purpose, a scoop stretch or vacuum mattress should be used. Not only does this abate pressure effects but limits the exposure of patients to unnecessary and detrimental log rolling.

'The log roll manoeuvre should be removed from the trauma response guidelines for patients with suspected spine injuries, as it creates significantly more motion in the unstable spine than the readily available alternatives. The only exception is the patient who is found prone, in which case the patient should then be log rolled directly on to the spine board utilizing a push technique'. (Conrad, 2012)

Both the UK consensus statement and the NICE 2016 guidelines argue for a preference to use a split device as opposed to a log roll when lifting patients with a suspected spinal injury. Conrad et al are very specific with their recommendation that log roll should only be used for prone patients. When the neutral respondents to the PHECC survey are excluded a slight majority (51.5%) are in favour of the statement i.e. lift with a split device and not a log roll.

Recommendation 11

Supine patients with suspected spinal injuries, where spinal motion restriction is being continued, should be lifted with a split device in preference to a log roll.

The aim of recommendation 11 is to minimise unnecessary patient movement, particularly on multisystem trauma/pelvic injury patients to avoid clot disruption, for packaging.

Question 8: Is transporting a patient on a long board an acceptable practice?

PHECC survey

Survey statement: *That patients with suspected spinal injury should be transported in an ambulance on a long board.*

The majority of respondents (65.1%) either disagreed or strongly disagreed with the statement.

The converse is that a minority 21.1% agreed or strongly agreed with the statement.

The balance (8.6%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a more positive response to the statement (in favour of transporting on a long board) from those that did not attend the seminar (37.1%) compared to those that did (7.2%). ($p = 0.00$).

		Seminar attended		Total
		Yes	No	
That patients, with suspected spinal injury, should be transported in ambulances on long boards	Strongly disagree	40	22	62
	Disagree	9	28	37
	Neutral	2	11	13
	Agree	3	26	29
	Strongly agree	1	10	11
Total		55	97	152

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

27. Do not transport people with suspected spinal injury on a longboard or any other extrication device.

A longboard should only be used as an extrication device.

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

1. The long spinal board is an extrication device solely.

With respect to methods of immobilisation, a firm distinction was made between extrication and transport/evacuation. The Faculty recommend the use of a long board solely as an extrication device and not for the transport of patients to hospital.

Position Statement: National Association of EMS Physicians and American College of Surgeons Committee on Trauma, 2014

Utilization of backboards for spinal immobilization during transport should be judicious, so that the potential benefits outweigh the risks.

Both UK papers are absolute against the use of a long board during transportation of a patient whereas the USA position paper although not supporting its use is not absolute against. When the neutral respondents to the PHECC survey are excluded a majority (71.2%) are against the statement i.e. opposed to transportation on a long board.

Recommendation 12

A long board is primarily an extrication device and should be used primarily for this purpose.

The aim of recommendation 12 is to minimise secondary injury and discomfort for patients by strongly discouraging the practice of transport on long board.

Question 9: Is the vacuum mattress the optimum device for transporting a patient with a suspected spinal injury?

PHECC survey

Survey statement: *That the optimum standard of care for transport of suspected spinal injured patient is use of a vacuum mattress regardless of journey time.*

Almost a majority of respondents (49.7%) either disagreed or strongly disagreed with the statement. The converse is that a sizeable minority 33.3% agreed or strongly agreed with the statement. The balance (17%) had a neutral response.

When respondents are divided into cohorts that attended the spinal injury seminar or not there is a large negative response to the statement from those that did not attend the seminar (64.3%) compared to those that did (23.6%). ($p = 0.0$).

		Seminar attended		Total
		Yes	No	
That the standard of care for transport of suspected spinal injured patients is use of a vacuum mattress regardless of journey time	Strongly disagree	5	32	37
	Disagree	8	31	39
	Neutral	6	20	26
	Agree	16	12	28
	Strongly agree	20	3	23
Total		55	98	153

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

21. When carrying out full in-line spinal immobilisation in adults, manually stabilise the head with the spine in-line using the following stepwise approach:

- Secure the person with head blocks and tape, ideally in a vacuum mattress

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

The Faculty recommend the use of a long board solely as an extrication device and not for the transport of patients to hospital. For this purpose, a scoop stretch or vacuum mattress should be used.

The US position paper is silent on this issue, however both UK papers are supportive of a vacuum mattress as a very suitable device for use during transportation. The Turf Club (Ireland) has adopted a policy of transportation on a vacuum mattress for all fallen jockeys that require transport to ED since 2015. When neutral respondents to the PHECC survey are excluded there is a majority (59.8%) opposed to the statement to use of a vacuum mattress regardless of journey time. As a result the recommendation has been modified to take into account the repackaging of patients with life threatening conditions may be contrary to optimum patient care.

Recommendation 13

The preferred mode for the transport of a patient with active spinal motion restriction is on a vacuum mattress. It is acknowledged that other devices may be utilised.

The aim of recommendation 13 is, following international evidence, to promote the use of vacuum mattress as the preferred option for transport of patients with query spinal injury.

Question 10: Should patients with penetrating trauma be immobilised in the pre-hospital environment?

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

4. Penetrating trauma with no neurological signs does not require immobilisation.

In line with other evidence, the meeting agreed that penetrating trauma to the spine does not require immobilisation in the absence of overt neurological signs.

Both the NICE 2016 guidelines and the US position paper are silent on this question. This question was not explored in the PHECC survey.

‘Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma’. (Haut, Kalish et al. 2010)

Recommendation 14

Patients presenting with penetrating trauma and without neurological signs should not have spinal motion restriction applied. Rapid transport to ED is essential to reduce mortality.

The aim of recommendation 14 is to minimise on-scene times for treatment and packaging of penetrating trauma patients.

Question 11: What is the optimum care for adult patients with non-standard spinal anatomy and presenting with a suspected spinal injury?

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

20. The use of spinal immobilisation devices may be difficult (for example in people with short or wide necks, or people with a pre-existing deformity) and could be counterproductive (for example increasing pain, worsening neurological signs and symptoms). In uncooperative, agitated or distressed people, including children, think about letting them find a position where they are comfortable with manual in-line spinal immobilisation.

‘Patients with pre-existing vertebral anatomical abnormalities e.g. ankylosing spondylitis should have their necks immobilised in a position of comfort. In such cases the use of collar is not compulsory and may be detrimental’ (CEM 2010)

Both the UK consensus and the US position paper are silent on this question. This question was not explored in the PHECC survey. The College of Emergency Medicine, however, are specific with their management guidelines for patients with ankylosing spondylitis with suspected cervical injury.

Recommendation 15

For patients with non-standard spinal anatomy e.g. ankylosing spondylitis, permit them to find a position where they are comfortable with manual spinal motion restriction. Non-standard methods such as rolled blankets may be utilised to accomplish spinal motion restriction.

The aim of recommendation 15 is to enable practitioners to use their judgement to package the patient appropriately for the patient's individual needs and particularly to reduce the incidence of inappropriate use of rigid cervical collars and other spinal injury devices on patients with non-standard spinal anatomy.

Question 12: Should decisions to implement active spinal motion restriction be reviewed by practitioners at higher clinical levels in the pre-hospital environment?

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

14. Do not carry out or maintain full in-line spinal immobilisation in people if:

- they have low-risk factors for cervical spine injury as identified and indicated by the Canadian C-spine rule, are pain free and are able to actively rotate their neck 45 degrees left and right
- they do not have any of the factors listed in recommendation 11

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

The consensus group was absolutely clear that a change is needed from a policy of immobilizing necks as much for the protection of the clinician as for that of the patient, to a system of selective immobilization designed to reduce the risks to the trauma victim.

Anecdotally paramedics are still requesting advanced paramedics to attend scene to 'rule out' spinal injury. This suggests a lack of confidence to make the clinical decision that a patient does not require spinal motion restriction. The UK consensus statement identified that spinal motion restriction is sometimes carried out in an effort to reduce the potential of litigation. Many recent US based EMS protocols are explicit about higher clinical levels reviewing the spinal motion restriction decisions and if appropriate ceasing active spinal motion restrictions.

'When possible, the highest level of care on scene will determine if spinal motion restriction is to be used or discontinued (collar removed, etc.)' (EMS 2015)

Recommendation 16

When possible, the highest PHECC registered practitioner level on scene will determine if spinal motion restriction is to be used or discontinued i.e. cease active spinal motion restriction

The aim of recommendation 16 is to enable practitioners to use their clinical judgement to discontinue active spinal motion restriction initiated by another practitioner or responder.

Question 13: What is the optimum care for paediatric patients with suspected spinal injury?

Spinal injury: assessment and initial Management NICE Guideline NG41, 2016

10. Be aware that applying the Canadian C-spine rule to children is difficult and the child's developmental stage should be taken into account.
12. Be aware that assessing children with suspected thoracic or lumbosacral spine injury is difficult and the child's developmental stage should be taken into account.
20. The use of spinal immobilisation devices may be difficult (for example in people with short or wide necks, or people with a pre-existing deformity) and could be counterproductive (for example increasing pain, worsening neurological signs and symptoms). In uncooperative, agitated or distressed people, including children, think about letting them find a position where they are comfortable with manual in-line spinal immobilisation.
22. When carrying out full in-line spinal immobilisation in children, manually stabilise the head with the spine in-line using the stepwise approach in recommendation 21 and consider:
 - involving family members and carers if appropriate
 - keeping infants in their car seat if possible
 - using a scoop stretcher with blanket rolls, vacuum mattress, vacuum limb splints or Kendrick extrication device.
65. For a child or vulnerable adult with spinal injury, enable their family members and carers to remain within eyesight if appropriate.
66. Work with family members and carers of children and vulnerable adults to provide information and support. Take into account the age, developmental stage and cognitive function of the child or vulnerable adult.
67. Include siblings of an injured child when offering support to family members and carers.

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

It was also felt that manual-in-line stabilisation is an appropriate substitute for a cervical collar and may well be better in certain patients such as those with a compromised airway, possible raised intracranial pressure, combative patients and children.

Whereas there is a paucity of papers on pre-hospital spinal injury management for paediatric patients the strongest recommendation comes from the NICE guidelines 2016 which recommends that the adult guidelines are followed with caution.

Recommendation 17

Paediatric patients following trauma should be assessed for spinal injury using the 'spinal injury rule in' considerations.

The aim of recommendation 17 is to enable the practitioner to assess and package the paediatric trauma patient using the adult criteria for spinal motion restriction, however clinical judgement should err on the side of caution due to difficulties with assessment of paediatric trauma.

Recommendation 18

The preferred mode for the transport of a paediatric patient with active spinal motion restriction is on a vacuum mattress or appropriately sized vacuum device. It is acknowledged that other options may be used.
Non-standard methods such as rolled blankets may be utilised to accomplish spinal motion restriction.

The aim of recommendation 18 is to enable vacuum mattress be used as the primary option for spinal motion restriction for paediatric patients.

Recommendation 19

Uncooperative paediatric patients shall not be forced into active spinal motion restriction as this is a greater risk to the patient.

The aim of recommendation 19 is to ensure that distressed or uncooperative paediatric patients are supported in a position of comfort and not have forced active spinal motion restriction applied.

Recommendation 20

Very young conscious paediatric patients with suspected spinal injury may have spinal motion restriction applied using the child's own car seat if it is intact following a collision, however they should not be forced into this position.

The aim of recommendation 20 is to enable undamaged child car seats be used for spinal motion restriction for appropriately aged paediatric patients.

Practitioners at Emergency Medical Technician (EMT) level

Question 14: What is the optimum care provided by EMTs for patients with suspected spinal injury?

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

"It is important to remember, however, that voluntary aid organisations will be looking for guidance in this challenging area. For these practitioners, guidance for the 'nonprofessional' managing trauma should err towards the side of over triage. They could with benefit, however, be made aware that cervical collars are not the panacea that they are often made out to be and that manual inline stabilisation (MILS) is often a more beneficial and acceptable modality compared with triple immobilisation. They should also be encouraged to consider moving away from spinal boards towards non-metallic scoops and the concept of minimal handling"

Recommendation 21

EMTs shall provide active spinal motion restriction for all patients with 'high risk' or 'low risk' factors present even in the absence of any of the 'spinal injury rule in' considerations.

The aim of recommendation 21 is to differentiate the scope of practice between EMTs and other PHECC practitioners.

Recommendation 22

Recommendations 1, 2, 4, 5, 7, 10, 11, 12, 13, 14, 15, 17, 18, 19 and 20 shall apply to EMTs when managing suspected spinal injury.

The aim of recommendation 22 is to outline the scope of practice for EMTs when managing pre-hospital spinal injury.

EMT level	Mechanism of injury	
	High Risk	Low Risk
'Spinal rule in' considerations	Active SMR	Active SMR
No 'spinal rule in' considerations	Active SMR	Active SMR

Responders and spinal injury management

Question 15: What is the optimum care provided by responders for patients with suspected spinal injury?

In an attempt to identify the extent and scope of the fire services involvement in spinal injury management a survey of all fire services in Ireland was undertaken by the Pre-Hospital Emergency Care Council (PHECC). As Dublin Fire Brigade is directly involved in the provision of an ambulance service and is a PHECC licensed CPG provider they were excluded from the survey. See details of survey in Appendix 3.

The fire services respondents indicated that;

- a) Twenty four (92.3%) carry a **cervical collar** as a standard item of equipment. Two respondents (7.7%) did not answer this question.
- b) Twenty six (100%) carry a **long board** as a standard item of equipment.
- c) Two (7.7%) carry an **orthopaedic (scoop) stretcher** as a standard item of equipment. Twenty four respondents (92.3%) did not answer this question.
- d) One (3.8%) carry a **vacuum mattress** as a standard item of equipment. Twenty five respondents (96.2%) did not answer this question.
- e) Fifteen (57.7%) carry an **extrication device** as a standard item of equipment. Eleven respondents (42.3%) did not answer this question.
- f) Nineteen services (73.1%) have an EFR clinical level involved in procurement for the fire service.
- g) Twenty five services (96.2%) have an EFR as the clinical leader (Casualty Carer) available to the fire service.
- h) Nine services (34.6%) utilise an instructor from a PHECC RI as the clinical level leading spinal injury management training within the fire service. One (3.8%) utilise an OFA instructor and the remainder did not answer this question.
- i) Twenty four services (92.3%) utilise a PHECC approved RI to certify clinical training within the fire service. One service (3.8%) use an in-house OFA instructor for this task.
- j) The frequency of spinal injury training practice within the fire services range from once per fortnight to never. The majority (65.4%) complete spinal injury management once per six months.
- k) Nineteen services (73.1%) utilise an EFR clinical level to oversee spinal injury training practice within the fire service. Five (19.1%) indicate that they have a PHECC practitioner to oversee the training.
- l) Two services (7.7%) have a Medical Advisor oversight available within the fire service.
- m) Eight (30.8%), the largest cohort, indicate that they are involved in actual spinal injury management within the fire service once per month. Six (23.1%) and 5 (19.2%) indicate that they are involved in providing spinal injury management once per week and once per fortnight respectively. The balance indicate every six months to one year.
- n) The vast majority 24 (92.3%) indicate that they do not maintain clinical records in the fire service.
- o) Fourteen (53.8%) fire services indicate that they are on scene first 50% of the time. Two (7.7%) state that they are on scene first 75% of the time.
- p) The vast majority 24 (92.3%) indicate that they use PHECC Clinical Practice Guidelines as the clinical standard operated by the fire service.
- q) Seven (26.9%) fire service believe that they are accredited for the practice of spinal injury management. The converse is that 19 (73.1%) do not think that they are accredited for the practice of spinal injury management yet they do so.
- r) Of the seven fire services that believe that they are accredited for the practice of spinal injury management, three (11.5%) indicate that they are PHECC accredited. This is not factual. One each to Civil Defence, DFB/RCSI and NAS. The final service is unsure and indicates with a '?'

Pre-hospital Spinal Immobilisation: An Initial Consensus Statement, UK 2012

"It is important to remember, however, that voluntary aid organisations will be looking for guidance in this challenging area. For these practitioners, guidance for the 'nonprofessional' managing trauma should err towards the side of over triage. They could with benefit, however, be made aware that cervical collars are not the panacea that they are often made out to be and that manual inline stabilisation (MILS) is often a more beneficial and acceptable modality compared with triple immobilisation. They should also be encouraged to consider moving away from spinal boards towards non-metallic scoops and the concept of minimal handling"

ILCOR Guidelines 2015

"Treatment Recommendations: We suggest against the use of cervical collars by first aid providers" (Zideman, Singletary et al. 2015)

Apart from the UK consensus statement 2012 and the ILCOR Guidelines 2015 a current reference to pre-hospital care by first responders of spinal injured patients could not be located in the literature. The recommendations are therefore based on both of these papers and extrapolation from practitioner guidelines. The recommendations are also influenced by the responses to the fire service spinal injury survey.

Recommendation 23

While waiting for the arrival of a practitioner, responders shall provide active spinal motion restriction for all patients if 'high risk' or 'low risk' factors are present.

The aim of recommendation 23 is to outline the rationale for responders in relation to spinal motion restriction.

Recommendation 24

Responders at FAR/OFA level should maintain the patient with suspected spinal injury in the position found while maintaining active spinal motion restriction.

The aim of recommendation 24 is to ensure that both 'high risk' and 'low risk' patients have minimised movement until a practitioner clinical assessment occurs.

Recommendation 25

Responders at EFR level should consider returning the head to neutral position (unless pain or resistance increases) and maintain active spinal motion restriction if spinal injury is suspected.

The aim of recommendation 25 is to ensure that both 'high risk' and 'low risk' patients have minimised movement until a practitioner clinical assessment occurs.

Recommendation 26

Responders at EFR level, who are operating on behalf of a licensed CPG provider, may apply a cervical collar while maintaining active spinal motion restriction to facilitate extraction.

The aim of recommendation 26 is to ensure that responders extricating both 'high risk' and 'low risk' patients will be assisted to minimised movement during extrication. It is understood that in some circumstances rescue from inaccessible areas and vehicle extrication may occur prior to a thorough spinal assessment.

Recommendation 27

Responders at EFR level, who are operating on behalf of a licensed CPG provider, may extricate a patient on an appropriate device in the absence of a practitioner if:

- (i) an unstable environment prohibits the attendance of a practitioner, or**
- (ii) while awaiting the arrival of a practitioner the patient requires rapid extrication to initiate emergency care**

The aim of recommendation 27 is to authorise responders at EFR level to extricate patients with suspected spinal injury in the absence of a practitioner.

Recommendation 28

Responders at EFR level, who are operating on behalf of a licensed CPG provider, if waiting for an ambulance response may remove an extricated patient from an extrication device and secure into a transport device.

The aim of recommendation 28 is to enable the responder at EFR level to appropriately package a patient while awaiting ambulance transport to minimise discomfort/secondary injury and reduce on-scene time.

Recommendation 29

Responders at EFR level, who are operating on behalf of a licensed CPG provider may request a patient, with a suspected spinal injury, who is ambulatory following trauma to lie down on a trolley stretcher or other device if he/she is able to do so. If unable to comply consider alternative methods.

The aim of recommendation 29 is to remove 'standing take down' as the standard of care for ambulatory patients.

Recommendation 30

Responders at EFR level, who are operating on behalf of a licensed CPG provider following the provision of spinal injury management, shall complete an Ambulatory Care Report (ACR) or Patient Care Report (PCR) and present the top copy to the practitioner transporting the patient to ED.

The aim of recommendation 30 is to ensure that all clinical interventions are documented and become part of the patient care record.

Recommendation 31

Recommendations 1, 2, 4, 5, 11, 12, 14, 15, 17, 19 and 20 shall apply to EFRs operating on behalf of a licensed CPG provider when managing suspected spinal injury.

The aim of recommendation 31 is to outline the scope of practice for EFRs when managing pre-hospital spinal injury.

Appendix 1

PHECC pre-hospital spinal injury management seminar speakers

Name	Position	Topic	Key message
Mr Brian Power	Programme Development Officer (PHECC)	Spinal injury a historic journey	A paper in 1966 identified two patients with missed spinal injuries which lead to the proliferation of spinal immobilisation, this was reinforced in 1980 by ATLS. Doing the same thing for 40 years, it's time to review practice.
Mr Seamus Morris	Consultant Orthopaedic Surgeon, Director National Spinal Injuries Unit, Mater Hospital	Spinal Injuries; A National Perspective	For neurological injury to occur in conjunction with spinal column injury a significant trauma has to be applied. Injury = bad pain, Clinical judgement is key. Transport direct to spinal injury unit – if cord injury present.
Dr Adrian McGoldrick	Medical Director, The Turf Club	Pre-Hospital Spinal Injuries among Jockeys	One (0.1%) spinal injury for 778 fallers in 2014.
Mr Martin O'Reilly	District Officer, EMS Support, Dublin Fire Brigade	Statutory Ambulance Service Providers Perspective	Clinical audit is key to introduction of new practices.
Dr David McManus	Medical Director, Northern Ireland Ambulance Service	Statutory Ambulance Service Providers Perspective	Potentially harming patients through immobilisation on long boards. Assess patients and then treat appropriately.
Mr David Hennelly	Clinical Development Manager, National Ambulance Service	Statutory Ambulance Service Providers Perspective	More towards spinal "rule in" not "rule out" Governance and support in decision making for practitioners.
Mr Tom Joyce	Assistant Chief of Operations, Fire and EMS Orange County, Virginia, USA	Statutory Ambulance Service Providers Perspective	Paramedic to explain why they did immobilise a patient at handover in ED. Support from Management and Medical Director when paramedics make clinical decisions is essential.
Mr Mark Dixon	Senior Lecturer, Paramedic Studies, University of Limerick	Pre-Hospital Spinal Injury Literature Review	There are no published high-level studies that assess the efficacy of spinal immobilisation in the pre-hospital setting
Dr David Menzies	Consultant in Emergency Medicine, St Vincent's University Hospital	Pre-Hospital Spinal Injuries; Emergency Department Perspectives	Irrational fear of spinal injury being missed. Educate, empower and support practitioners to make clinical decisions.
Dr Niamh Collins	Consultant in Emergency Medicine, Connolly Hospital	Pre-Hospital Spinal Injuries; Emergency Department Perspectives	A retrospective study at Connolly Hospital of 623 trauma patients identified a spinal injury rate of 3.3% and clinically significant injury rate of 2%. Impaired communication (TBI/alcohol/drugs) warrants additional consideration in spinal decision rule-making.
Mr Raymond Quinn	Solicitor and Paramedic	Pre-Hospital Spinal Injury Litigation	No reported cases of pre-hospital spinal injury litigation in both Ireland and UK. Provide standard of care – ensure competence of paramedics will protect from litigation.
Mr Grant Lewis	Business Development Manager, Ferno (UK) Ltd.	Pre-Hospital Spinal Immobilisation equipment standards	Spinal injury lifting devices should not bend more than 50 mm in the centre when lifted head to toe.
Mr Mark Dixon	Senior Lecturer, Paramedic Studies, University of Limerick	Pre-Hospital Extrication	Patient self – extrication causes least movement to c-spine area. Spinal "rule in" not "rule out" should be the standard of care.

Appendix 2

What is a Distracting Injury?

The NEXUS literature defines a distracting injury as “a condition thought by the clinician to be producing pain sufficient to distract the patient from a second (neck) injury.”¹

The Canadian C-spine rule describes distracting injuries as “injuries... that are so severely painful that the neck examination is unreliable.”²

Common examples include long bone fractures, visceral injuries requiring surgical consultation, large lacerations, degloving injuries, crush injuries, large burns, and injuries producing acute functional impairment.

Heffernan added any painful chest injury³ and Konstantinidis showed that the 4% of patients with painless neck fracture all had rib fractures and/or severe chest tenderness. Chest injury may be added to the description of distracting injuries.

Everything is unfortunately still subjective. A distracting injury is something so painful that the patient cannot pay attention to other injuries, they feel nothing but the distractor. How can an objective decision be made to decide whether the injury is a distracting one or not?

This suggested method by Paramedic trainer, Bill Johnston, Colorado USA, is not evidence based but is used in his clinical practice. Details available at <http://prehospitalwisdom.blogspot.ie/2014/11/what-is-distracting-injury.html>

“So what you want to do is pinch one of the patient’s fingers without them being able to see the finger. They have to feel the pinch. Cover their hand with a blanket, cover their eyes, whatever makes sense to hide their fingers. Squeeze a finger, about as hard as you do when you check capillary refill and hold it. Ask the patient which finger you are squeezing. If they get the answer correct, especially if you repeat the test with lighter and lighter touch, they can separate the pain from their other injury from their other neurologic inputs. They are also likely to be able to recognize midline cervical tenderness when asked. They are demonstrably not distracted. Thus, if they can identify which finger you are touching, they probably don’t have a distracting injury”.

Bill Johnston, Paramedic, Colorado USA.

1. 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. *NEJM* 2000;343:94-99.
2. Stiell IG, Wells GA, Vandemheen KL, Clement CM, et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA* 2001;286:1841-1848.
3. Heffernan DS, Schermer CR, Lu SW. What defines a distracting injury in cervical spine assessment? *J Trauma* 2005;59:1396-1399.

Appendix 3

Irish Fire Service Survey (93% response)

Involvement in procurement

		Frequency	Percent
Valid	Nil	1	3.8%
	EFR	19	73.1%
	EMT	5	19.2%
	P	1	3.8%
	Total	26	100.0%

Casualty carer in the fire services

		Frequency	Percent
Valid	OFA	1	3.8
	EFR	25	96.2
	Total	26	100.0

Clinical level leading spinal injury management training

		Frequency	Percent
Valid	OFA Instructor external	1	3.8
	Instructor from PHECC RI	9	34.6
	Total	10	38.5
Missing	Did not answer	16	61.5
	Total	26	100.0

Responsible for certifying spinal injury management training

		Frequency	Percent
Valid	OFA Instructor in house	1	3.8
	PHECC approved RI	24	92.3
	Total	25	96.2
Missing	System	1	3.8
	Total	26	100.0

Frequency of spinal injury management training

		Frequency	Percent
Valid	Fortnight	1	3.8
	Month	4	15.4
	Six months	17	65.4
	Year	2	7.7
	Two years	1	3.8
	Never	1	3.8
	Total	26	100.0

Clinical level overseeing spinal injury management training

		Frequency	Percent
Valid	EFR	19	73.1
	EMT	3	11.5
	P	1	3.8
	AP	1	3.8
	Total	24	92.3
Missing	System	2	7.7
Total		26	100.0

Medical advisor oversight available

		Frequency	Percent
Valid	Yes	2	7.7
	No	23	88.5
	Total	25	96.2
Missing	System	1	3.8
Total		26	100.0

Perform spinal injury management on a patient

		Frequency	Percent
Valid	Once per week	6	23.1
	Once per fortnight	5	19.2
	Once per month	8	30.8
	Once per six months	3	11.5
	Once per year	3	11.5
	Total	25	96.2
Missing	System	1	3.8
Total		26	100.0

Maintain clinical records

		Frequency	Percent
Valid	Yes	1	3.8
	No	24	92.3
	Total	25	96.2
Missing	System	1	3.8
Total		26	100.0

Percentage of time on-scene first

		Frequency	Percent
Valid	5%	3	11.5
	10%	1	3.8
	20%	3	11.5
	50%	14	53.8
	75%	2	7.7
	Total	23	88.5
Missing	System	3	11.5
Total		26	100.0

Clinical standard used

		Frequency	Percent
Valid	PHECC CPGs	24	92.3
	Other	1	3.8
	None	1	3.8
	Total	26	100.0

Accredited for the practice of spinal injury management

	Frequency	Percent
Valid Yes	7	26.9
No	19	73.1
Total	26	100.0

Who accredits the service for spinal injury management?

	Frequency	Percent
Valid Not answered	19	73.1
?	1	3.8
Civil Defence	1	3.8
DFB/RCSI	1	3.8
NAS (training dept.)	1	3.8
PHECC	3	11.5
Total	26	100.0

References;

Ahn, H., et al. (2011). "Pre-hospital care management of a potential spinal cord injured patient: a systematic review of the literature and evidence-based guidelines." *J Neurotrauma* **28**(8): 1341-1361.

An interdisciplinary expert panel of medical and surgical specialists involved in the management of patients with potential spinal cord injuries (SCI) was assembled. Four key questions were created that were of significant interest. These were: (1) what is the optimal type and duration of pre-hospital spinal immobilization in patients with acute SCI?; (2) during airway manipulation in the pre-hospital setting, what is the ideal method of spinal immobilization?; (3) what is the impact of pre-hospital transport time to definitive care on the outcomes of patients with acute spinal cord injury?; and (4) what is the role of pre-hospital care providers in cervical spine clearance and immobilization? A systematic review utilizing multiple databases was performed to determine the current evidence about the specific questions, and each article was independently reviewed and assessed by two reviewers based on inclusion and exclusion criteria. Guidelines were then created related to the questions by a national Canadian expert panel using the Delphi method for reviewing the evidence-based guidelines about each question. Recommendations about the key questions included: the pre-hospital immobilization of patients using a cervical collar, head immobilization, and a spinal board; utilization of padded boards or inflatable bean bag boards to reduce pressure; transfer of patients off of spine boards as soon as feasible, including transfer of patients off spinal boards while awaiting transfer from one hospital institution to another hospital center for definitive care; inclusion of manual in-line cervical spine traction for airway management in patients requiring intubation in the pre-hospital setting; transport of patients with acute traumatic SCI to the definitive hospital center for care within 24 h of injury; and training of emergency medical personnel in the pre-hospital setting to apply criteria to clear patients of cervical spinal injuries, and immobilize patients suspected of having cervical spinal injury.

CEM (2010). Guideline on the management of alert, adult patients with potential cervical spine injury in the Emergency Department. London, The College of Emergency Medicine.

The prevalence of cervical spine injury following blunt trauma from 65 published studies is 2.8% overall, and ~2% in less selective, prospective studies of consecutive patients 3-4. Less than 1% of patients will suffer a cord injury but for those that do it can be devastating to both the individual and their family. The practice of immobilising a patient's neck (and body) following potential neck trauma has been widely adopted through fear of causing or exacerbating a spinal injury. However, spinal immobilisation is not without consequence in financial terms, or morbidity, for the 98% or so who do not have a significant cervical spine injury.

Chan, D., et al. (1996). "Backboard versus mattress splint immobilization: a comparison of symptoms generated." *J Emerg Med* **14**(3): 293-298.

The study objective was to compare spinal immobilization techniques to a vacuum mattress-splint (VMS) with respect to the incidence of symptoms generated by the immobilization process. We used a prospective, cross-over study in a university hospital setting. Participants consisted of 37 healthy volunteers without history of back pain or spinal disease. Interventions consisted of two phases. In Phase I, subjects were randomly assigned to be immobilized on either a wooden backboard or a mattress-splint for 30 min. The incidence and

severity of any symptoms generated by the immobilization process were recorded. In Phase II, the two groups were again tested after a 2-week washout period, with the method of immobilization being reversed. Symptoms and severity were again recorded. Pain symptoms were confined to four anatomic sites: Occipital prominence, lumbosacral spine, scapulae, and cervical spine. After adjusting for the effect of order of exposure, subjects were 3.08 times more likely to have symptoms when immobilized on a backboard than when immobilized on the VMS. They were 7.88 times more likely to complain of occipital pain and 4.27 times more likely to complain of lumbosacral pain. Severity of occipital and lumbosacral pain was also significantly greater during backboard immobilization. We conclude that, when compared to a VMS, standard backboard immobilization appears to be associated with an increased incidence of symptoms in general and an increased incidence and severity of occipital and lumbosacral pain in particular.

Connor, D., et al. (2013). "Pre-hospital spinal immobilisation: an initial consensus statement." Emerg Med J **30**(12): 1067-1069.

This paper reviews the current evidence available on the practice of spinal immobilisation in the prehospital environment. Following this, initial conclusions from a consensus meeting held by the Faculty of Pre-hospital Care, Royal College of Surgeons of Edinburgh in March 2012 are presented.

Dixon, M., et al. (2015). "Confirmation of suboptimal protocols in spinal immobilisation?" Emerg Med J **32**(12): 939-945.

BACKGROUND: Spinal immobilisation during extrication of patients in road traffic collisions is routinely used despite the lack of evidence for this practice. In a previous proof of concept study (n=1), we recorded up to four times more cervical spine movement during extrication using conventional techniques than self-controlled extrication. **OBJECTIVE:** The objective of this study was to establish, using biomechanical analysis which technique provides the minimal deviation of the cervical spine from the neutral in-line position during extrication from a vehicle in a larger sample of variable age, height and mass. **METHODS:** A crew of two paramedics and four fire-fighters extricated 16 immobilised participants from a vehicle using six techniques for each participant. Participants were marked with biomechanical sensors and relative movement between the sensors was captured via high-speed infrared motion analysis cameras. A three-dimensional mathematical model was developed and a repeated-measures analysis of variance was used to compare movement across extrication techniques. **RESULTS:** Controlled self-extrication without a collar resulted in a mean movement of 13.33 degrees from the neutral in-line position of the cervical spine compared to a mean movement of 18.84 degrees during one of the equipment-aided extrications. Two equipment-aided techniques had significantly higher movement ($p<0.05$) than other techniques. Both height ($p=0.003$) and mass ($p=0.02$) of the participants were significant independent predictors of movement. **CONCLUSIONS:** These data support the findings of the proof of concept study, for haemodynamically stable patients controlled self-extrication causes less movement of the cervical spine than extrications performed using traditional prehospital rescue equipment.

EMS, N. (2015). http://www.health.ny.gov/professionals/ems/pdf/t-8_suspected_spinal_injury_2015.pdf.

Haut, E. R., et al. (2010). "Spine immobilization in penetrating trauma: more harm than good?" J Trauma **68**(1): 115-120; discussion 120-111.

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. **CONCLUSIONS:** Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.

Luscombe, M. D. and J. L. Williams (2003). "Comparison of a long spinal board and vacuum mattress for spinal immobilisation." Emerg Med J **20**(5): 476-478.

OBJECTIVES: This study was designed to compare the stability and comfort afforded by the long spinal board (backboard) and the vacuum mattress. **METHODS:** Nine volunteers wearing standardised clothing and rigid neck collars were secured on to a backboard and vacuum mattress using a standard strapping arrangement. An operating department table was used to tilt the volunteers from 45 degrees head up to 45 degrees head down, and additionally 45 degrees laterally. Movements of the head, sternum, and pubic symphysis (pelvis) from a fixed position were then recorded. The comfort level during the procedure was assessed using a 10 point numerical rating scale (NRS) where 1=no pain and 10=worst pain imaginable. **RESULTS:** The mean body movements in the head up position (23.3 v 6.66 mm), head down (40.89 v 8.33mm), and lateral tilt (18.33 v 4.26mm) were significantly greater on the backboard than on the vacuum mattress ($p < 0.01$ for all planes of movement). Using the NRS the vacuum mattress (mean score=1.88) was significantly more comfortable than the backboard (mean score=5.22) ($p < 0.01$). **CONCLUSIONS:** In the measured planes the vacuum mattress provides significantly superior stability and comfort than a backboard.

Morrissey, J. F., et al. (2014). "Spinal motion restriction: an educational and implementation program to redefine prehospital spinal assessment and care." Prehosp Emerg Care **18**(3): 429-432.

INTRODUCTION: Prehospital spine immobilization has long been applied to victims of trauma in the United States and up to 5 million patients per year are immobilized mostly with a

cervical collar and a backboard. **OBJECTIVE:** The training of paramedics and emergency medical technicians on the principals of spine motion restriction (SMR) will decrease the use of backboards. **METHODS:** The training for SMR emphasized the need to immobilize those patients with a significant potential for an unstable cervical spine fracture and to use alternative methods of maintaining spine precautions for those with lower risk. The training addressed the potential complications of the use of the unpadded backboard and education was provided about the mechanics of spine injuries. Emergency medical services (EMS) personnel were taught to differentiate between the critical multisystem trauma patients from the more common moderate, low kinetic energy trauma patients. A comprehensive education and outreach program that included all of the EMS providers (fire and private), hospitals, and EMS educational institutions was developed. **RESULTS:** Within 4 months of the policy implementation, prehospital care practitioners reduced the use of the backboard by 58%. This was accomplished by a decrease in the number of patients considered for SMR with low kinetic energy and the use of other methods, such as the cervical collar only. **CONCLUSION:** The implementation of a SMR training program significantly decreases the use of backboards and allows alternative methods of maintaining spine precautions.

NICE (2016). Spinal injury: Assessment and initial management, National Institute for Health and Care Excellence.

Approximately 1000 people sustain a new spinal cord injury (SCI) each year in the UK. These injuries are associated with serious neurological damage, and can result in paraplegia, quadriplegia or death. Currently there are no 'cures' for SCI and in the UK there are 40,000 people living with long term disabilities as a result of such injuries. Care of an acutely spinally injured patient is aimed towards the preservation of function and prevention of disability. Whilst primary prevention of SCI is not within the scope of this guideline, the avoidance of secondary injury, both mechanical and physiological, is crucial in limiting the effects of acute SCI. Spinal injuries do not always occur in isolation and the acute management of the patient with multiple injuries is covered in the NICE clinical guideline on major trauma and will be cross referred to when appropriate. This guideline addresses both cord and column injury. While approximately 15% of people with a spinal column fracture or dislocation will have a cord injury, the majority of people with a cord injury will have an accompanying column injury. Of particular importance is the avoidance of secondary SCI in the presence of an unstable spinal column. Avoidance of a cord injury mandates an awareness of the possibility of column injury and resultant protection of the spinal cord from the time of injury. This requires a standardised and effective approach for spinal immobilisation in both the pre-hospital and hospital phases. Spinal injuries can be the result of a wide range of events and the injury may not be immediately obvious. The mechanism of injury ranges from a fall from a standing position in the elderly to an axial load to the head (by diving or in a high-speed motor vehicle collision). As a result, the assessment and the recognition of potential spinal column and cord injuries can be challenging. Across the UK there is variation in pre-hospital spinal immobilisation strategies. Effective immobilisation is pivotal to spinal protection and must be carried out and maintained from the injury site to definitive care. Carrying out full in-line spinal immobilisation can be challenging in the pre-hospital environment with fewer trained personnel available at the injury site than in the hospital resuscitation room. Accurate assessment and documentation of the spinal injury that includes motor and sensory function is important to provide a baseline for on-going care and this guideline sets out the vital assessments and data collection parameters. The devastating effects of SCI are well known to the public, which makes providing accurate information to patients, carers and their relatives

of particular importance. Information about the process of care should be provided early but inaccurate prognostic prediction either pessimistic or optimistic can be devastating. The scope of this guideline is the assessment, imaging and early management of spinal injury and does not address rehabilitation. It is important to recognise that early management is intrinsically connected to rehabilitation and some later complications may be avoided with changes in early care. Early and ongoing collaborative multidisciplinary care across a trauma network is vital in ensuring that the patient with a spinal injury receives the best possible care.

Oteir, A. O., et al. (2014). "The prehospital management of suspected spinal cord injury: an update." Prehosp Disaster Med **29**(4): 399-402.

INTRODUCTION: Spinal cord injury (SCI) is a serious condition that may lead to long-term disabilities placing financial and social burden on patients and their families, as well as their communities. Spinal immobilization has been considered the standard prehospital care for suspected SCI patients. However, there is a lack of consensus on its beneficial impact on patients' outcome. **OBJECTIVE:** This paper reviews the current literature on the epidemiology of traumatic SCI and the practice of prehospital spinal immobilization. **DESIGN:** A search of literature was undertaken utilizing the online databases Ovid Medline, PubMed, CINAHL, and the Cochrane Library. The search included English language publications from January 2000 through November 2012. **RESULTS:** The reported annual incidence of SCI ranges from 12.7 to 52.2 per 1 million and occurs more commonly among males than females. Motor vehicle collisions (MVCs) are the major reported causes of traumatic SCI among young and middle-aged patients, and falls are the major reported causes among patients older than 55. There is little evidence regarding the relationship between prehospital spinal immobilization and patient neurological outcomes. However, early patient transfer (8-24 hours) to spinal care units and effective resuscitation have been demonstrated to lead to better neurological outcomes. **CONCLUSION:** This review reaffirms the need for further research to validate the advantages, disadvantages, and the effects of spinal immobilization on patients' neurological outcomes.

White, C. C. t., et al. (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." Prehosp Emerg Care **18**(2):306-314.

Field spinal immobilization using a backboard and cervical collar has been standard practice for patients with suspected spine injury since the 1960s. The backboard has been a component of field spinal immobilization despite lack of efficacy evidence. While the backboard is a useful spinal protection tool during extrication, use of backboards is not without risk, as they have been shown to cause respiratory compromise, pain, and pressure sores. Backboards also alter a patient's physical exam, resulting in unnecessary radiographs. Because backboards present known risks, and their value in protecting the spinal cord of an injured patient remains unsubstantiated, they should only be used judiciously. The following provides a discussion of the elements of the National Association of EMS Physicians (NAEMSP) and American College of Surgeons Committee on Trauma (ACS-COT) position statement on EMS spinal precautions and the use of the long backboard. This discussion includes items where there is supporting literature and items where additional science is needed.

Zideman, D. A., et al. (2015). "Part 9: First aid: 2015 International Consensus on First Aid Science with Treatment Recommendations." Resuscitation **95**: e225-261.



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