

A Multicenter Program to Implement the Canadian C-Spine Rule by Emergency Department Triage Nurses

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Study objective: The Canadian C-Spine Rule has been widely applied by emergency physicians to safely reduce use of cervical spine imaging. Our objective is to evaluate the clinical effect and safety of real-time Canadian C-Spine Rule implementation by emergency department (ED) triage nurses to remove cervical spine immobilization.

Methods: We conducted this multicenter, 2-phase, prospective cohort program at 9 hospital EDs and included alert trauma patients presenting with neck pain or with cervical spine immobilization. During phase 1, ED nurses were trained and then had to demonstrate competence before being certified. During phase 2, certified nurses were empowered by a medical directive to “clear” the cervical spine of patients, allowing them to remove cervical spine immobilization and to triage to a less acute area. The primary outcomes were clinical effect (cervical spine clearance by nurses) and safety (missed clinically important cervical spine injuries).

Results: In phase 1, 312 nurses evaluated 3,098 patients. In phase 2, 180 certified nurses enrolled 1,408 patients (mean age 43.1 years, women 52.3%, collision 56.5%, and cervical spine injury 1.1%). In phase 2 and for the 806 immobilized ambulance patients, the primary outcome of immobilization removal by nurses was 41.1% compared with 0% before the program. The primary safety outcome of cervical spine injuries missed by nurses was 0. Time to discharge was reduced by 26.0% (3.4 versus 4.6 hours) for patients who had immobilization removed. In only 1.3% of cases did nurses indicate their discomfort with applying the Canadian C-Spine Rule.

Conclusion: We clearly demonstrated that ED triage nurses can successfully implement the Canadian C-Spine Rule, leading to more rapid and comfortable management of patients without any threat to patient safety. Widespread adoption of this approach should improve care and comfort for trauma patients, and could decrease length of stay in our very crowded EDs. [Ann Emerg Med. 2018;■:1-9.]

Please see page XX for the Editor's Capsule Summary of this article.

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INTRODUCTION

Canadian emergency departments (EDs) annually treat 1.3 million patients who have experienced blunt trauma from falls or motor vehicle collisions and who are at risk for cervical spine injury.¹ Most such patients are alert and stable adults and less than 1% have a cervical spine fracture.² Most trauma victims transported in ambulances are protected by a backboard, collar, and head restraints. On arrival at the ED, they are sent to high-acuity resuscitation rooms, where they remain fully immobilized for hours until physician assessment and diagnostic imaging are complete. This lengthy immobilization is often unnecessary, adds significantly to patient discomfort, and

also adds to the burden of crowded EDs.³⁻⁵ These patients also occupy valuable space in ED acute areas. We previously developed the Canadian C-Spine Rule, a clinical decision rule composed of simple clinical variables.⁶ The Canadian C-Spine Rule was designed to allow clinicians to “clear” the cervical spine without diagnostic imaging and to decrease immobilization times. We validated the accuracy of the rule when used by physicians and successfully implemented it at 12 hospitals to demonstrate safe decreased use of diagnostic imaging, in a cluster-randomized design.^{7,8}

Nurses normally do not evaluate the cervical spine of trauma patients, but we believe that they should be able to

Editor's Capsule Summary*What is already known on this topic*

The Canadian C-Spine Rule can safely aid physicians in deciding who does not need cervical spine imaging after trauma, but physicians may be delayed arriving to the bedside.

What question this study addressed

Can nurses safely use the Canadian C-Spine Rule during emergency department care?

What this study adds to our knowledge

In a 2-phase, multisite trial, nurses successfully trained on use and then removed cervical collars for 41% of 806 injured patients, without any missed spine lesions, resulting in a shorter time until immobilization removal and until discharge.

How this is relevant to clinical practice

With nurse training, early use of the Canadian C-Spine Rule is feasible and safe.

safely evaluate alert and stable ambulance patients by using the Canadian C-Spine Rule on patient arrival to the triage station. This would allow them to remove cervical spine immobilization of low-risk patients on arrival and triage them to a less acute area. Consequently, these patients could then be managed much more rapidly, comfortably, and efficiently in other areas of the ED. An expanded role for nurse decisionmaking has the potential to improve trauma care efficiency in all Canadian hospitals. However, little research has been conducted on the ability of ED triage nurses to clear patient cervical spines.⁹⁻¹² We previously showed the accuracy of the Canadian C-Spine Rule when used by ED triage nurses at 6 hospitals, but nurses were not permitted to remove immobilization.¹³ In addition, there is very little evidence about the role of nurses in applying immobilization to injured patients who present without cervical spine collars.

Our goal was to prospectively evaluate the effect on patient care of real-time Canadian C-Spine Rule implementation by ED triage nurses assessing stable trauma patients at multiple hospitals. In this 2-phase program, our primary objectives were to evaluate the clinical effect (clearance and lengths of stay) and safety of removing cervical spine immobilization from patients arriving by ambulance. Our secondary goal was to evaluate the effect of nurses using the Canadian C-Spine Rule to apply collars to patients who arrive without immobilization. In addition,

we sought to assess nurse compliance in applying the Canadian C-Spine Rule, as well as their comfort in doing so.

MATERIALS AND METHODS**Study Design and Setting**

We conducted this multicenter, 2-phase, prospective cohort program that evaluated outcomes during a 30-month period in the ED at 9 teaching hospitals in Ontario, the largest province in Canada, with a population of 13.6 million. The 9 hospitals had a combined annual volume of approximately 670,000 ED visits. All EDs were staffed by full-time certified emergency physicians and emergency medicine residents.

During phase 1 (certification), all ED nurses who performed triage activities were trained and then had to demonstrate competence by accurately assessing 10 patients before being certified. During phase 2 (implementation), all triage nurses who had become certified were empowered by a medical directive to "clear" the cervical spine of patients, allowing them to remove cervical spine immobilization of Canadian C-Spine Rule-negative patients and triage them to a less acute area.

Selection of Participants

We enrolled consecutive, alert adults who were in stable condition and who presented with potential cervical spine injury after acute blunt trauma, including patients with posterior neck pain and those presenting by ambulance with immobilization of the cervical spine. The patients had to be alert and cooperative. We defined "alert" as a Glasgow Coma Scale score of 15; their condition had to be stable, defined as normal vital signs (systolic blood pressure >90 mm Hg and respiratory rate between 10 and 24 breaths/min), and the injury had to have occurred within the previous 48 hours. The primary study group was patients who arrived by ambulance with immobilization, and the secondary groups were those who arrived without immobilization, whether by ambulance or on foot.

We excluded patients younger than 16 years; those with penetrating trauma, acute paralysis, or known vertebral disease (ie, ankylosing spondylitis, rheumatoid arthritis, cervical spine stenosis, or previous cervical spine surgery); and those who were returning for reassessment of a previously treated injury or who had been referred from another hospital. The hospital research ethics boards either waived the need for approval or approved the program without the need for informed patient consent at the ED visit.

The focus of phase 1 was the training and then certification of nurses through successful patient assessments. At a project startup meeting, we trained registered nurse site champions through means of didactic presentations, video, and practical sessions. In a 90-minute session, the principal investigator presented previous evidence of the Canadian C-Spine Rule and described in detail how the rule is applied to patients. This was followed by a video demonstrating the techniques of Canadian C-Spine Rule application. Finally, all the nurses underwent another 90-minute session of hands-on practice with simulated patients.

The site champions, with the assistance of the registered nurse program coordinator, then oversaw local training of the ED nurses, incorporating the same didactic material presented in a compact disc, a knowledge quiz, and then similar hands-on practice sessions. Then each nurse had to accurately evaluate 10 eligible trauma patients in the ED, completing a case record form for each. Finally, each nurse had to have 3 cases simultaneously evaluated by a second observer. Certification status was determined by the local nurse champion and the study coordinator, who each reviewed all data forms.

The focus of phase 2 was having certified triage nurses remove the immobilization by medical directive, and potentially move patients to lower-acuity areas of the ED. The nurses underwent a 60-minute review session, and the physician group of each hospital approved a medical directive empowering the nurses to remove immobilization according to the Canadian C-Spine Rule. Simultaneously, nurses were able to immobilize patients who arrived by ambulance without a collar or those who were ambulatory, according to the Canadian C-Spine Rule.

Data Collection and Processing

All potentially eligible patients were screened prospectively, on arrival, by the triage nurses and a log was kept for patients not enrolled. Data were obtained for patient characteristics and outcomes from the ED, diagnostic imaging, and hospital health records. ED patient visit logs were monitored for 30 days after the initial visit to identify return visits by patients who did not undergo imaging during their initial visit or may have experienced a missed cervical spine fracture. The surveillance strategy included the regional neurosurgical centers in each of the program cities.

Outcome Measures

The primary outcomes were measures of clinical effect and patient safety. The primary outcome for clinical effect

was cervical spine clearance by nurses (ie, proportion of eligible trauma patients who had immobilization removed by nurses). The primary safety outcome was number of missed clinically important cervical spine injuries⁶ identified in patients who had their immobilization removed by nurses. Clinically important cervical spine injury was previously defined as any injury requiring surgery or a hard collar after assessment by a spine surgeon. A secondary clinical effect outcome was length of time in the ED (ie, total lengths of time from arrival until cervical spine clearance and then from registration to discharge for enrolled patients who were neither admitted nor had a clinically significant injury). The secondary safety measure was the number of serious adverse outcomes (ie, development of neurologic deficit after cervical spine clearance by the ED nurse).

Other outcomes included nurse accuracy in overall interpretation of the rule (immobilization required versus no immobilization required) and nurse comfort with and use of the rule as indicated on the data collection form for each patient, using a 5-point scale from very comfortable to very uncomfortable.

Primary Data Analysis

Our results focus on phase 2 and we examine 3 groups of patients separately: ambulance arrival with immobilization, ambulance arrival without immobilization, and ambulatory. Data were presented descriptively as appropriate for continuous, ordinal, and categorical outcomes. Given that nurses rarely if ever remove cervical spine immobilization in Canada or elsewhere, we determined a priori that removal of immobilization exceeding 25% would denote successful implementation. We believed that the safety of the program would be clearly established if no fractures were missed by the nurses. Statistical testing was not performed for these outcomes. Sample size was based on the number of cases that could be enrolled by the 9 volunteering sites during two 12-month phases. We expected that more than 1,000 cases would be enrolled during each phase, allowing robust estimates of effect and safety.

RESULTS

The project enrolled a total of 4,506 patients in the 2 phases combined, with each site progressing at its own speed (Table E1, available online at <http://www.annemergmed.com>). Phase 1 (certification) commenced in December 2010 and finished in October 2011, with a total of 4,546 patients screened for eligibility and 3,098 patients enrolled by 312 nurses (Tables E2 and E3, available online

at <http://www.annemergmed.com>). One hospital withdrew participation after phase 1 because of difficulties with compliance. Phase 2 (implementation) commenced in August 2011 and finished October 20, 2012, with a total of 2,229 patients screened for eligibility and 1,408 patients enrolled by 180 participating triage nurses at the 8 remaining EDs. There were fewer nurses in phase 2 because of the loss of one site and because not all nurses had met the training target of 10 ED cases. The 214 patients deemed not eligible had one or more exclusion criteria (Table E4, available online at <http://www.annemergmed.com>).

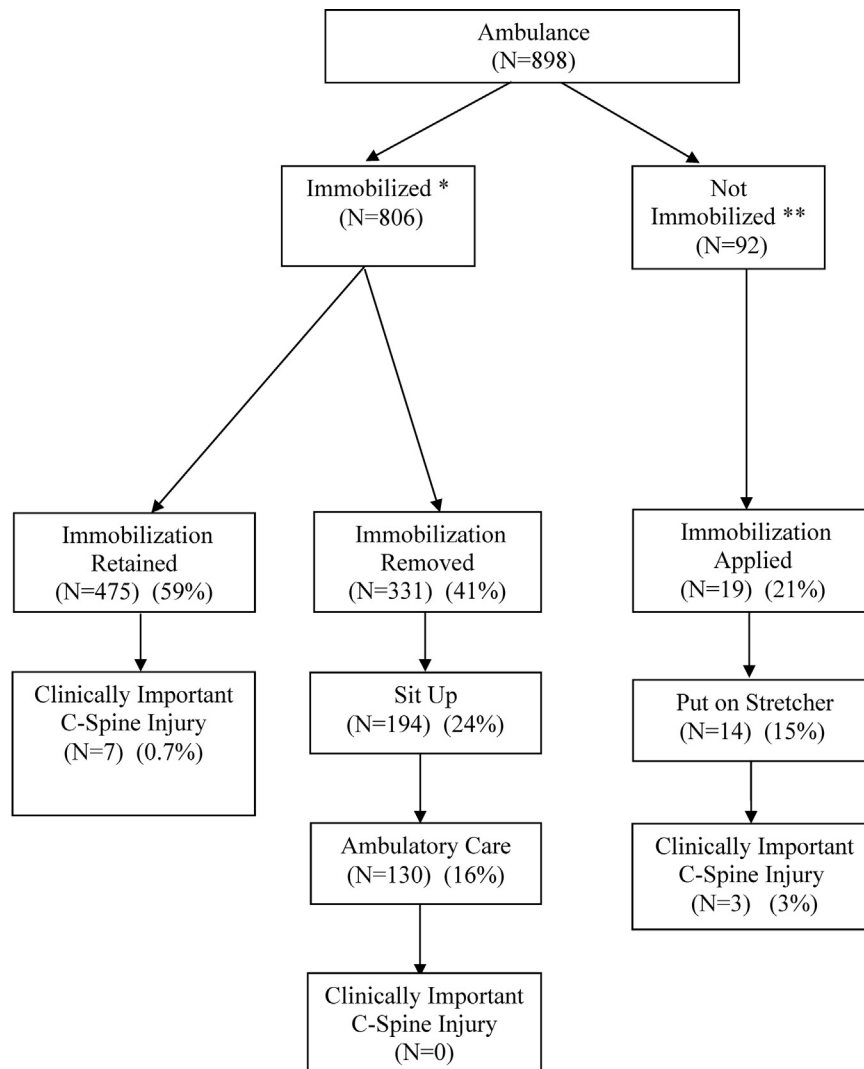
Simultaneously, another 285 potentially eligible patients were not assessed because certified nurses were not on duty.

We focus on the results of phase 2, when implementation had occurred. There were 806 patients in the primary study group, arriving with immobilization, and another 602 presenting with neck pain but no immobilization (Table 1, Figures 1 and 2). Overall, these 1,408 eligible and assessed patients were aged 16 to 105 years, 52.3% were women, 56.5% were involved in a motor vehicle collision, 63.8% arrived by ambulance, 5.6%

Table 1. Characteristics of the 1,408 cervical spine injury patients in phase 2 implementation.

Characteristics	All Patients (N=1,408)	Ambulance Immobilized (N=806)	Ambulance Not Immobilized (N=92)	Ambulatory (N=510)
Age, y				
Mean (SD)	43.1 (17.9)	43.6 (16.0)	49.8 (20.1)	41.1 (17.8)
Range	16–105	16–98	18–99	16–105
Sex, female (%)	737 (52.3)	425 (52.7)	56 (61.8)	256 (50.0)
Hospital (%)				
North York General Hospital	436 (31.0)	214 (26.4)	47 (51.1)	175 (34.3)
University Health Network	230 (16.3)	93 (11.5)	11 (12.0)	126 (24.7)
St. Michael's Hospital	193 (13.7)	98 (12.2)	19 (20.7)	76 (15.0)
Sunnybrook Health Sciences Centre	64 (4.5)	30 (3.7)	3 (3.3)	31 (6.1)
Thunder Bay Regional HSC	80 (5.7)	49 (6.1)	1 (1.1)	30 (5.9)
Hôpital Montfort	68 (4.8)	42 (5.2)	8 (8.7)	18 (3.5)
Health Sciences North	49 (3.5)	45 (5.6)	3 (3.3)	4 (0.8)
London Health Sciences Center–Victoria Hospital	288 (20.4)	235 (29.2)	3 (3.3)	50 (9.8)
Mechanism of injury (%)				
Motor vehicle collision	797 (56.5)	506 (62.8)	59 (64.0)	232 (45.5)
Motorcycle	342 (24.2)	162 (20.1)	21 (22.8)	159 (31.2)
Sports	43 (3.1)	11 (1.4)	3 (3.3)	29 (5.7)
Bicycle crash	84 (6.0)	54 (6.7)	2 (2.2)	28 (5.5)
Other	142 (10.0)	73 (9.1)	7 (7.6)	62 (12.2)
Arrived by ambulance	898 (63.8)	806 (100.0)	92 (100.0)	0 (0)
Diagnostic imaging of cervical spine performed (%)				
Radiography	612 (43.4)	339 (42.1)	39 (42.4)	234 (45.9)
Computed tomography	420 (29.8)	230 (29.2)	24 (26.1)	166 (32.5)
Magnetic resonance imaging	249 (17.7)	139 (17.2)	16 (17.4)	94 (18.4)
	10 (0.7)	3 (0.4)	1 (1.1)	6 (1.2)
Type of injury of cervical spine (%)				
Clinically important				
Fracture	16 (1.1)	7 (1.0)	3 (3.3)	6 (1.2)
Dislocation	16 (1.1)	6 (0.7)	3 (3.3)	7 (1.4)
Ligamentous instability	0 (0)	0 (0)	0 (0)	0 (0)
Central cord contusion	1 (0.1)	1 (0.1)	0 (0)	0 (0)
	2 (0.1)	0 (0)	0 (0)	2 (0.4)
Clinically unimportant				
	3 (0.6)	0 (0)	0 (0)	3 (0.6)
Stabilizing treatments				
	16 (1.1)	6 (0.7)	2 (2.3)	8 (1.6)
Internal fixation	2 (0.1)	2 (0.3)	0 (0)	0 (0)
Halo	0 (0)	0 (0)	0 (0)	0 (0)
Brace	0 (0)	0 (0)	0 (0)	0 (0)
Rigid collar	14 (1.0)	4 (0.5)	2 (2.3)	8 (1.6)
Intervals, median (IQR), h				
Arrival to initial nurse assessment	0.1 (0.05–0.3)	0.2 (0.1–0.4)	0.1 (0.03–0.2)	0.1 (0.05–0.3)
Initial nurse assessment to discharge	3.2 (1.9–4.8)	3.4 (2.1–5.1)	2.5 (1.7–4.6)	2.9 (1.8–4.5)
Arrival to time of discharge	3.5 (2.3–5.1)	3.8 (2.5–5.3)	2.7 (1.8–4.7)	3.1 (2.0–4.6)
Admission to hospital	79 (5.6)	57 (7.1)	6 (6.7)	16 (3.1)
Death as a result of cervical spine injury	1 (0.1)	0 (0)	0 (0)	1 (0.2)
IQR, Interquartile range.				

IQR, Interquartile range.



* According to correct application of the CCR, 385 (48%) patients would not require immobilization

** According to correct application of the CCR, 35 (38%) patients would require immobilization to be applied

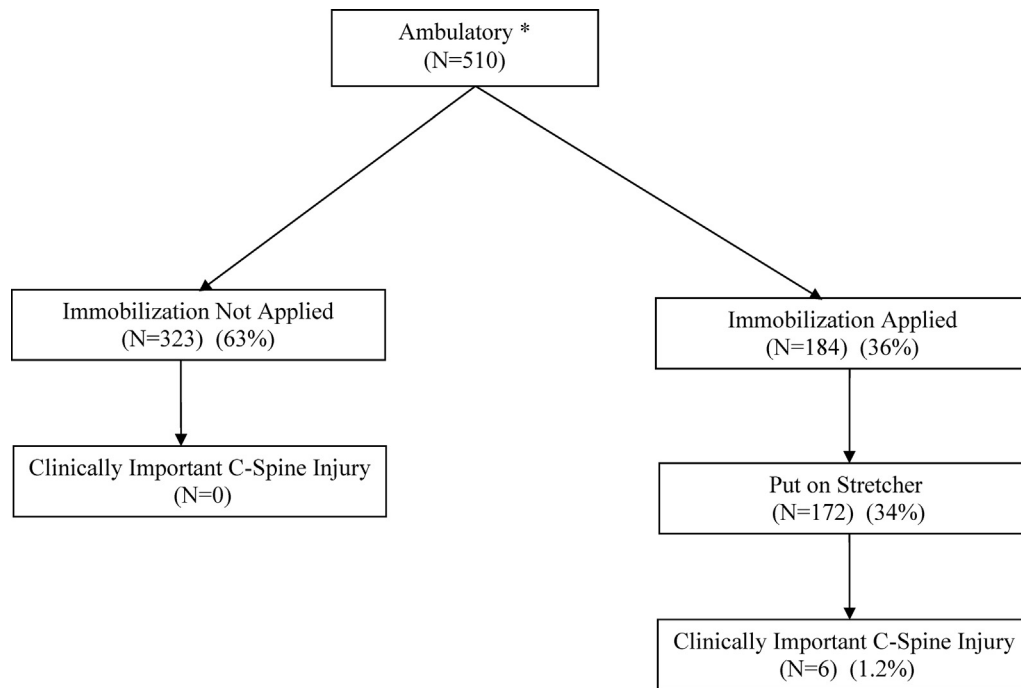
Figure 1. Disposition of 898 eligible patients who arrived by ambulance during phase 2 implementation of the Canadian C-Spine Rule (CCR).

were admitted, and 1.1% had clinically important injuries of the cervical spine. Of the 16 patients who sustained clinically important injuries, 2 (0.1%) required internal fixation and 14 (1.0%) required rigid collars. Diagnostic imaging was performed in 43.4% of cases. These patients were similar to those in phase 1 (Tables E2 and E3, available online at <http://www.annemergmed.com>).

Table 2 lists the prevalence of each Canadian C-Spine Rule criterion in the various patient cohorts, with need for immobilization indicated for immobilized ambulance cases (52.2%), nonimmobilized ambulance cases (38.0%), and ambulatory patients (45.3%). Findings from the history

indicated that 38.6% of patients experienced immediate onset of neck pain and 16.5% had paresthesias in their extremities. On physical examination, 27.6% of patients had midline neck tenderness, and 48.4% were able to rotate their neck.

Figure 1 illustrates the flow and management of 898 ambulance patients. For the 806 immobilized patients, 47.8% were judged by the Canadian C-Spine Rule to not need immobilization and 41.1% actually had it removed by the nurses. In addition to the cervical spine clearance, 24% of patients were able to sit up, and 16% were moved to an ambulatory area. The 6 patients with clinically important



* According to correct application of the CCR, 231 (45%) patients would require immobilization to be applied

Figure 2. Disposition of 510 eligible ambulatory patients during phase 2 implementation of the Canadian C-Spine Rule.

injuries were correctly identified by nurses and no patient who had immobilization removed proved to have an injury. Among the 92 ambulance patients who had not been immobilized, nurses applied a cervical spine collar to 21% and 3 of these proved to have an injury.

Figure 2 shows that 36.1% of 510 eligible ambulatory patients had immobilization applied by the nurses and 6 proved to have a clinically important injury. Among the patients who were not immobilized, there were no cervical spine injuries.

For ambulance patients arriving with immobilization, we compared ED waiting intervals for those who had

immobilization removed (N=305) to those who did not have immobilization removed by nurses (N=411). Total time in the ED was less (3.8 versus 4.9 hours), as was time from nursing assessment to discharge (3.4 versus 4.6 hours). We also found that total time in the ED was 1.2 hours less for patients triaged to an ambulatory area versus those who were not. The overall mean time from arrival to nurse clearance was 0.3 hours.

Table 3 shows acceptance and compliance for the nurses. In only 1.3% of cases did the nurse indicate on the 5-point scale that he or she was uncomfortable or very uncomfortable following the Canadian C-Spine Rule.

Table 2. Canadian C-Spine Rule findings in the 1,408 patients in phase 2 implementation.

	All Patients (N=1,408)	Ambulance Immobilized (N=806)	Ambulance Not Immobilized (N=92)	Ambulatory (N=510)
Findings from history (%)				
Dangerous mechanism	318 (22.6)	201 (25.0)	14 (15.2)	103 (20.2)
Paresthesias in extremities	232 (16.5)	131 (16.3)	9 (9.8)	92 (18.0)
Simple rear-end MVC	241 (17.1)	106 (13.2)	26 (28.1)	109 (21.4)
Ambulatory at any time	560 (39.8)	233 (28.9)	54 (58.7)	273 (53.5)
Immediate onset of neck pain	544 (38.6)	351 (43.6)	35 (38.0)	158 (31.0)
Findings from physical examination (%)				
Sitting position in ED	297 (21.1)	7 (0.9)	41 (44.6)	249 (48.8)
Neck tenderness midline	389 (27.6)	206 (25.6)	26 (28.3)	157 (31.8)
Able to rotate neck	682 (48.4)	351 (43.6)	58 (63.0)	273 (53.5)
Cervical spine immobilization required	687 (48.8)	421 (52.2)	35 (38.0)	231 (45.3)

MVC, motor vehicle collision.

Table 3. Comfort and compliance with implementation of the Canadian C-Spine Rule as evaluated by the ED triage nurses.

Measurement	All Patients (N=1,408)	Ambulance Immobilized (N=806)	Ambulance Not Immobilized (N=92)	Ambulatory (N=510)
Comfort with using CCR (%)				
Very comfortable	618 (43.9)	345 (42.8)	40 (43.5)	233 (45.7)
Comfortable	347 (24.6)	192 (23.8)	30 (32.6)	125 (24.5)
Neutral	107 (7.6)	55 (6.8)	9 (9.8)	43 (8.4)
Uncomfortable	16 (1.1)	13 (1.6)	0	3 (0.6)
Very uncomfortable	3 (0.2)	3 (0.4)	0	0
Compliance with applying CCR (%)				
Rule=no immobilization	—*	385 (47.8)	—	—
Immobilization removed	—	331 (41.1)	—	—
Rule=immobilization	—	—	35 (38.0)	231 (45.3)
Immobilization applied	—	—	19 (20.7)	184 (36.1)

*Dashes indicate "not applicable."

Compliance with removal of immobilization was particularly good, with collars being removed in 41.1% of cases (versus 0% at baseline). Nurses were less likely to apply collars to nonimmobilized ambulance patients but did so frequently for ambulatory patients who were judged to be at risk by the Canadian C-Spine Rule.

LIMITATIONS

The program findings may not be generalizable to different practice environments such as small, rural hospitals. Nevertheless, we are optimistic that this approach to change in nursing practice could be applied directly or with some modifications almost anywhere in North America and Europe. Although we did not use a randomized design, we are confident that the magnitude of the clearance rate shows clear evidence of clinical effect without bias. Nurses did not always apply immobilization to the nonimmobilized patients according to the Canadian C-Spine Rule, but this was not the main focus of the program.

It is possible but unlikely that some cervical spine injury cases were missed if patients returned to a different hospital. In most cases, the study hospitals were the regional spine centers; others had close connections with the spine hospitals. We did not compare the performance of nurses with that of physicians in clearing spines but believe that our model is very effective in any hospital where ED patients are treated by triage nurses before physicians.

DISCUSSION

This large, multicenter implementation program by nursing follows a series of previous studies to derive,

validate, and implement the Canadian C-Spine Rule by physicians. The findings confirm the safety and clinical effect of having ED triage nurses apply the Canadian C-Spine Rule to clinically clear the cervical spine of alert and stable trauma patients. Overall, 180 nurses removed immobilization in 41.4% of ambulance patients (N=331) compared with 0% before the program. To our knowledge, few if any North American EDs have a nurse clearance rate greater than zero. There were no missed cervical spine injuries and no serious adverse events. In the secondary cohort of potential neck injury patients who arrived without immobilization, the nurses also demonstrated safety by identifying all 9 cervical spine injuries. Compliance and comfort with use of the rule were high. Removal of immobilization by nurses was associated with a reduction in ED length of stay, an important issue in this era of crowded EDs.

Although there has been little research completed to date, there is strong support for the concept of nurses clearing the cervical spine of alert and stable trauma patients.¹⁴⁻¹⁶ Previous studies have been relatively small, with only one involving actual cervical spine clearance by nurses. Four evaluated interobserver agreement between nurses and physicians for cervical spine assessment.^{9-11,17} Pitt et al¹² found that UK nurses were able to clear the cervical spine in 59 of 112 cases in what we believe to be the first report of clearance by nurses. We could find no reports of nurses actually clearing the cervical spine in North America. Much of our previous research had focused on limiting the use of immobilization and imaging by physicians rather than nurses.⁶⁻⁸

The strength of our program was that it was multicenter and included a variety of academic and community hospitals, including 6 trauma centers. The concise training

program was developed and modified and can be shared with interested hospitals. The participating nurses expressed a high level of comfort in using the rule.

This project successfully demonstrated that many nurses at multiple sites could be trained to successfully and safely apply the Canadian C-Spine Rule to rationalize use of immobilization. First, nurses can safely affect clinical care by removing unnecessary immobilization. Second, they can improve patient safety by applying cervical spine collars to patients who are at risk but arrive without immobilization. The approach used for this project could be applied to most Western EDs, including academic and community hospitals. Trained, certified ED triage nurses should be allowed to clear the cervical spine by local medical directive. Training must be comprehensive and emphasize inclusion and exclusion criteria. We believe the spread of this knowledge would greatly improve care and comfort for people with traumatic injuries while reducing wait times in crowded EDs.

Future initiatives should focus on knowledge translation to various stakeholder groups, including emergency physicians and nurses, as well as paramedics, to ensure widespread use of the Canadian C-Spine Rule tool.¹⁸

We have clearly demonstrated that ED triage nurses can successfully implement the Canadian C-Spine Rule, leading to more rapid and comfortable management of patients without any missed cervical spine injuries or threat to patient safety. There was a substantial rate of removal of cervical spine immobilization, with trained nurses clearing 41.1% of appropriate alert and stable patients and triaging them to a less acute area of the ED. In addition, nurses correctly identified nonimmobilized patients who proved to have cervical spine injuries. All EDs should consider adopting this practice by instituting a rigorous certification and implementation program. This would improve care and comfort for trauma patients while decreasing wait times in crowded EDs.

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