

# Can nurses apply the Canadian C-Spine Rule? A pilot study

Anne-Maree Kelly, MD, MClInEd, FACEM,\* Luke Bradshaw,† Debra Kerr, BN, MBL‡

## ABSTRACT

**Objective:** The aim of this study was to determine the inter-rater agreement between physicians and nurses regarding eligibility for application of the Canadian C-Spine Rule (CCR) and assessment of the criteria of the CCR.

**Methods:** In this observational study, nurses and physicians independently assessed the CCR criteria in a convenience sample of patients with potential C-spine injury. Data were entered onto separate data sheets. The outcomes of interest were the inter-rater agreement between nurse and physician regarding eligibility for application of the rule, for assessment of each component of the rule and for interpretation of the rule overall, assessed by kappa analysis.

**Results:** In total, 88 cases were eligible for analysis. Physicians and nurses agreed on which patients were eligible for CCR application in 96.6% of cases. Inter-rater agreement for most CCR criteria was good ( $\kappa > 0.61$ ), with the exception of midline tenderness ( $\kappa = 0.58$ ) and range of motion, which most nurses did not test.

**Conclusion:** This study shows that nurses have the potential to reliably apply the Canadian C-Spine Rule but require further training in the assessment of midline tenderness and range of motion.

**Key words:** cervical spine clearance; nurses; Canadian C-Spine Rule

## RÉSUMÉ

**Objectif :** Cette étude avait comme objectif de déterminer la concordance inter-évaluateurs entre les médecins et les infirmières quant à l'admissibilité à l'application de la Règle canadienne concernant la colonne cervicale (Canadian C-Spine Rule) (CCR) et à l'évaluation des critères de la CCR.

**Méthodes :** Lors de cette étude d'observation, des infirmières et des médecins évaluèrent indépendamment les critères de la CCR au sein d'un échantillon de commodité de patients atteints d'une blessure potentielle à la colonne cervicale. Les données furent notées sur des fiches de données séparées. Les résultats étudiés furent la concordance inter-évaluateurs entre l'infirmière et le médecin concernant l'admissibilité à l'application de la règle, l'évaluation de chaque composante de la règle et l'interprétation de la règle dans son ensemble, évaluée à l'aide de l'analyse statistique kappa.

**Résultats :** Au total, 88 cas furent jugés admissibles à l'analyse. Les médecins et les infirmières s'entendaient sur les patients chez qui la CCR devrait être appliquée dans 96,6 % des cas. Le niveau de concordance inter-évaluateurs pour la plupart des critères de la CCR était bon ( $\kappa > 0,61$ ),

\*Professor and Director, Joseph Epstein Centre for Emergency Medicine Research, Western Health, and The University of Melbourne, Melbourne, Victoria, Australia

†Medical student, Advanced Medical Science Program, The University of Melbourne

‡Program Manager, Joseph Epstein Centre for Emergency Medicine Research, Western Health, and The University of Melbourne

Received: Sept. 29, 2003; final submission: Dec. 20, 2003; accepted: Dec. 26, 2003

*This article has been peer reviewed.*

*Can J Emerg Med* 2004;6(3):161-4

à l'exception de la sensibilité au toucher sur le plan médian ( $\kappa = 0,58$ ) et l'amplitude des mouvements, que la plupart des infirmières n'ont pas testées.

**Conclusion :** La présente étude démontre que les infirmières sont capables d'appliquer de façon fiable la Règle canadienne concernant la colonne cervicale mais ont besoin d'une formation complémentaire quant à l'évaluation de la sensibilité au toucher sur le plan médian et de l'amplitude des mouvements.

## Introduction

Traditional trauma teaching mandates that injury victims who might have a neck injury should have spinal immobilization until cervical spine (C-spine) imaging has been performed.<sup>1</sup> Recently, the requirement for C-spine radiographs has been challenged by the development of 2 decision rules that facilitate clearance of the C-spine on clinical grounds.<sup>2,3</sup> This should translate into lower x-ray rates and shorter periods of discomfort for patients if hard cervical collars can be removed earlier. Time in hard collars could be reduced further if nurses can clinically clear the C-spine without waiting for a physician.

Stiell and colleagues<sup>4</sup> showed that the kappa value for interpretation of the Canadian C-Spine Rule (CCR) by physicians was 0.66, with misclassification in 8.7% of cases. Previous research has shown that nurses can accurately apply similar clinical decision rules for ordering ankle and knee radiographs.<sup>5,6</sup>

The aim of this study was to determine the inter-rater agreement between emergency department (ED) physicians and nurses for eligibility for application of the CCR, for assessment of the CCR criteria and for overall interpretation of the rule.

## Methods

### *Patients and setting*

This prospective observational study was conducted between Nov. 29, 2002, and Mar. 7, 2003, in the ED of the Western Hospital in Melbourne, Australia. It is a substudy of a larger project evaluating the impact of the CCR on x-ray ordering rates in adults with potential neck injuries, and looking at whether CCR implementation reduces patients' time in hard collars. Alert stable adults with potential C-spine injuries were eligible for study.

### *Intervention*

ED nurses and physicians prospectively identified a convenience sample of eligible patients, then independently applied the CCR. Only senior nurses who had completed a

competency assessment for the removal of hard cervical collars were allowed to remove collars and independently assess range of motion. Less experienced nurses observed the range of motion test conducted by ED physicians.

### *Data collection*

Nurse and physician assessments were conducted independently from each other. Staff members were blinded to their colleagues' assessments (except where less experienced nurses observed range of motion testing; this occurred in a small number of cases and was documented on data collection forms). Data were entered onto separate data sheets and collated. Missing data are reported as such.

### *Outcomes and data analysis*

The outcomes of interest were the inter-rater agreement between nurse and physician regarding eligibility for application of the rule, for assessment of each component of the rule and for overall interpretation of the rule. Agreement was assessed using Cohen's unweighted kappa statistic (<http://faculty.vassar.edu/lowry/kappa.html>). The study was approved by our institutional research and ethics committee.

## Results

During the study period 132 patients were screened. Of these, 6 were not clinically stable and alert, and 1 did not have a potential C-spine injury, leaving 125 potentially eligible patients. In 37 cases, data forms were incomplete or unmatched, therefore 88 cases had sufficient data for analysis. These 88 comprised the study sample. Table 1 summarizes patient demographics, mode of arrival, injury mechanism, application of hard collars and prevalence of clinically significant C-spine injuries, showing that there was only 1 such injury in the study cohort.

Figure 1 summarizes patients screened and enrolled, and assessments performed. Physicians and nurses agreed on which patients were eligible to have the CCR applied to them in 85 of 88 cases (96.6%), and nurses did not include any patients whom physicians assessed as ineligible for rule application. Table 2 shows that inter-rater agreement

for the CCR criteria was generally good, except for the assessment of midline tenderness ( $\kappa = 0.58$ ) and range of motion ( $\kappa = 0.29$ ). Nurses independently assessed range of motion in only 12 of 24 eligible cases, and were more likely than physicians to report the presence of midline tenderness (nurses 49% of evaluated patients v. physicians 32%). The kappa statistic for agreement between physicians and nurses for interpretation of the overall rule in individual patients was 0.55 (95% confidence interval [CI], 0.30–0.80), based on the 62 cases where both physician and nurse assessed (or observed) range of motion. Agreement on classification based on the combined criteria of the CCR, excluding range of motion assessment, was 0.86 (95% CI, 0.74–0.97). Physicians would have cleared 28% (23/81) of cases using the rule, and nurses would have cleared 16% (10/62) of cases ( $p < 0.001$ ), where the rule was completely applied.

## Discussion

Our results suggest that nurses have the potential to reliably apply the CCR to assess patients with potential C-spine injuries. These findings are concordant with other research demonstrating that nurses can successfully apply clinical decision rules like the Ottawa Knee Rule and the Ottawa Ankle Rules in adult and pediatric patients presenting to the ED.<sup>5,6</sup> We found, however, that in patients with potential C-spine injury, nurses were uncomfortable assessing range of motion and were more likely than physicians to report midline tenderness. Of note, some ED

physicians also have reservations about assessing range of motion, and in Stiell and colleagues' validation study, range of motion was not assessed in 10.5% of eligible cases.<sup>4</sup> We also found that nurses interpreted all rule crite-

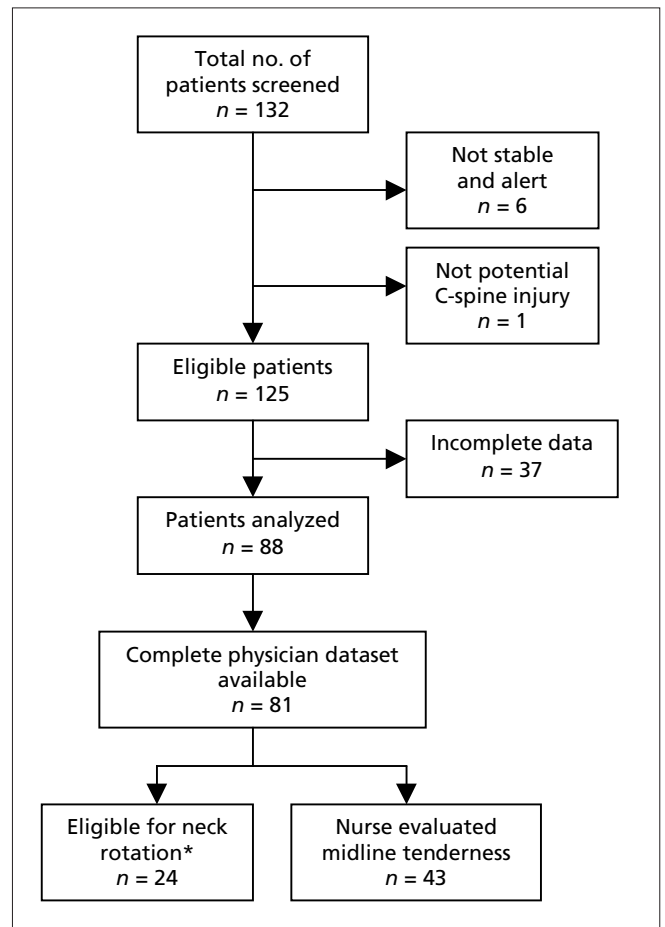


Fig. 1. Study flowsheet. \*Note: Nurses assessed or observed neck rotation in a total of 62 cases.

**Table 1. Patient characteristics, injury mechanism and cervical-spine (C-spine) injury prevalence**

Variables	No. (and %)* of patients
Median age (and range)	37 (17–87)
Men	53 (60)
Arrived by ambulance	76 (86)
<b>Injury mechanism</b>	
Motor vehicle accident	49 (56)
Fall	14 (16)
Motorcycle accident	8 (9)
Pedestrian	6 (7)
Collision / Struck by object	6 (7)
Bicyclist	4 (4)
Equestrian	1 (1)
Hard collar applied	80 (91)
Clinically significant C-spine injuries	1 (1)

\*Unless otherwise specified.

**Table 2. Nurse–physician agreement for components of the Canadian C-Spine Rule**

Overall rule and rule criteria	n	Kappa	95% CI
Overall rule application	62	0.55	0.30–0.80
Age $\geq 65$	83	0.95	0.85–1.00
Dangerous mechanism	83	0.86	0.74–0.98
Paraesthesia	83	1.00	1.00–1.00
Simple rear-end collision	43	0.69	0.43–0.94
Sitting position in ED	43	0.87	0.70–1.00
Ambulatory at any time	43	0.73	0.51–0.95
Delayed onset of pain	43	0.61	0.35–0.87
Absence of midline tenderness	43	0.58	0.33–0.82
Range of motion	14	0.29	0.00–0.93

CI = confidence interval; ED = emergency department

ria more conservatively than did physicians and were more conservative in their overall interpretation of the rule, clearing fewer C-spines injuries than doctors; however, our kappa value of 0.55 for overall interpretation of the rule in individual patients was similar to the 0.66 reported by Stiell and colleagues for inter-physician agreement.<sup>4</sup> We found higher levels of agreement for *paraesthesia* and *sitting during examination* than reported in Stiell and cohorts' work comparing physicians,<sup>2</sup> but a lower level of agreement for the assessment of midline tenderness. The poorer agreement with respect to midline tenderness might be explained by reluctance on the part of nursing staff to examine the neck.

### Feasibility of nurse evaluation

During the educational phase of this study, institutional medicolegal concerns focused on clinical examination of the neck and range of motion testing in patients with potential C-spine injuries. These concerns led to severe limitations on the grade of nurses permitted to assess range of motion. Consequently, many nurse assessments were based on nurses observing the physician evaluation rather than doing it independently. Hopefully, as more data on the safety and accuracy of the CCR are published and further experience is gained, these limitations can be overcome.

Assessment of range of motion and C-spine tenderness was a new practice for the nurses involved in the study. This highlights important differences in physicians' and nurses' training and clarifies the need for extensive instruction and support if nurses are to feel comfortable assessing the C-spine for range of motion and tenderness. A much larger study is needed to confirm that nurses can safely and accurately apply the CCR.

Our findings suggest that nursing staff may be able to clinically clear some patients with potential C-spine injuries rather than waiting for physician assessment in all cases. This would significantly reduce time in a hard collar and the associated discomfort. Because some collars are applied at the time of ED triage, nurse application of the CCR may allow hard collars to be avoided altogether in some patients. It is also possible that the CCR could be applied by paramedics in the prehospital setting, avoiding the application of hard collars in a proportion of cases.

### Limitations

Our sample size was small — a factor of resource availability. In addition, it was a convenience sample, but this should not have introduced a systematic bias. Physicians and nurses sometimes failed to record elements of the decision

rule, which further limited the sample size for some analyses. The study was conducted at one site with a high proportion of senior nurses, so these results may or may not be generalizable to other settings, particularly those with fewer senior nurses. Finally, in this study, only one patient had a clinically important C-spine injury, and application reliability for any clinical prediction rule may depend on the prevalence of the target condition, hence the prevalence of key clinical findings in the population studied.

### Conclusion

This study suggests that nurses have significant potential to reliably apply the CCR but require further training with regard to assessment of midline tenderness and range of motion.

**Acknowledgement:** This work was conducted as part of the Advanced Medical Science Program of The University of Melbourne, Melbourne, Victoria, Australia.

**Competing interests:** None declared.

### References

1. American College of Surgeons. Advanced trauma life support instructor manual. 5th ed. Chicago: The College; 1993.
2. Stiell IG, Wells GA, Vandemheen KL, Clement CM, Lesiuk H, De Maio VJ, et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA* 2001;286:1841-8.
3. 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. National Emergency X-Radiography Utilization Study Group [published erratum appears in *N Engl J Med* 2001;344(6):464] *N Engl J Med* 2000;343(2):94-9.
4. Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, et al. The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma. *N Engl J Med* 2003;349(26):2510-8.
5. Karpas A, Hennes H, Walsh-Kelly CM. Utilization of the Ottawa ankle rules by nurses in a pediatric emergency department. *Acad Emerg Med* 2002;9(2):130-3.
6. Kec RM, Richman PB, Szucs PA, Mandell M, Eskin B. Can emergency department triage nurses appropriately utilize the Ottawa Knee Rules to order radiographs? An implementation trial. *Acad Emerg Med* 2003;10(2):146-50.

**Correspondence to:** Professor Anne-Maree Kelly, Joseph Epstein Centre for Emergency Medicine Research, Western Hospital, Private Bag, Footscray 3011, Australia; 03 8345 6315, fax 03 9318 4790, Anne-Maree.Kelly@wh.org.au