

# The Actual Application of the NEXUS and Canadian C-Spine Rules by Emergency Physicians

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## Citation

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## Abstract

**Objectives:** We studied the current usage of the NEXUS and Canadian C-Spine Rules (CCR). **Methods:** A nine-question survey was offered to emergency physicians. **Results:** 61 physicians completed the survey instrument. 34 respondents (56%) reported using NEXUS >75% of the time, while 6 (10%) reported using CCR >75% of the time. The most common reason cited for not using NEXUS was patient insistence on obtaining a radiograph. The most common reason for not using CCR was that it is too difficult to remember or use in real-time. When asked to write down the rule from memory, 21 of the 34 (62%) who used NEXUS >75% of the time reported the rule correctly, whereas 2 of the 6 (33%) who used CCR >75% of the time reported the rule correctly. **Conclusions:** The physicians in this study used NEXUS more often than CCR. A significant proportion of physicians did not recall either one correctly, indicating that either cost-effectiveness or safety of their use may be questionable.

## INTRODUCTION

The National X-Radiography Utilization Study Group low-risk rules (NEXUS) and the Canadian C-spine Rule (CCR) are two commonly used clinical decision rules (CDRs) used to reduce the number of cervical spine radiographs obtained in blunt trauma victims [12]. The creation of these rules was inspired by the fact that clinicians liberally order cervical-spine radiographs in blunt trauma victims but the majority of these studies are negative for injury [1]. By supplementing clinical judgement with objective historical data and physical findings, CDRs such as these can simplify complex decision-making and achieve cost savings without compromising patient care [3].

NEXUS is a prospective observational study that involved twenty-one hospitals in the United States [1]. The study tested criteria to exclude cervical injury without radiography that were previously determined by several smaller studies. A total of 34,069 patients were evaluated with radiographs, of which 818 (2.4%) had radiographically documented cervical-spine injury. Applying their criteria (Table 1) identified all but 8 of the 818 patients with cervical spine injury, yielding a sensitivity of 99.0%. The specificity of this CDR was 12.9%, and if applied retrospectively, could have reduced radiograph ordering by 12.6% with minimal added risk to patients.

Table 1: The NEXUS Low-Risk Criteria

No tenderness at the posterior midline of the cervical spine  
No focal neurologic deficit  
Normal level of alertness  
No evidence of intoxication  
No clinically apparent, painful injury to distract from the pain of a cervical-spine injury

CCR is a prospective cohort study that was conducted in ten hospitals in Canada [2]. The study enrolled 8,924 patients, of which 6,185 (68.9%) were evaluated radiographically and the remainder were contacted by phone at 14 days. Several clinical factors were evaluated, and using the kappa coefficient, logistic regression and chi-squared recursive partitioning, a rule was created and validated (Table 2). In the study, 151 patients (1.7%) had clinically important c-spine injury, and the rule had a sensitivity of 100% and a specificity of 42.5%, meaning that applying the rule could have led to a radiography ordering rate of 58.2%, a relative reduction of 15.5% without significant added risk to patients.

Table 2: The Canadian C-spine Rule

Question 1: Is there any high-risk factor that mandates radiography (i.e., age  $\geq$ 65 years, dangerous mechanism, or paresthesias in extremities)?

Question 2: Is there any low-risk factor present that allows safe assessment of range of motion (i.e., simple rear-end

motor vehicle collision, sitting position in ED, ambulatory at any time since injury, delayed onset of neck pain, or absence of midline C-spine tenderness)?

Question 3: Is the patient able to actively rotate neck 45° to the left and right?

If the answer is “yes” to Question 1, or “no” to Questions 2 and 3 then cervical spine radiography is required.

Several years have passed since these CDRs have been published. The purpose of this study is to determine their current use in actual EM practice, as well as the reasons why they are not being used. Additionally, as errors in correctly applying CDRs may reduce their sensitivity and specificity, we wish to determine if they are being applied in correct fashion by those physicians who use them frequently.

**METHODS**

The study was conducted in Massachusetts. An anonymous paper survey was administered to one group of emergency physicians. An identical survey was then distributed as an internet survey to representatives of emergency departments throughout the state for on-line completion and distribution of the invitation to their colleagues. Respondents self-selected after receiving the invitation to complete the survey. No compensation was provided.

A nine question anonymous survey instrument was used to determine the characteristics of the respondents, their current use of the two CDRs, their reasons for not using the CDRs with several pre-determined answers and possibility for open-ended response, and open-ended questions asking respondents to repeat the two CDRs from memory.

Surveys were administered on a custom-made template using the website [www.surveymonkey.com](http://www.surveymonkey.com) between July and September, 2005. Statistics were calculated using SigmaStat v3.1 (Systat Software, Inc., San Jose, CA, USA).

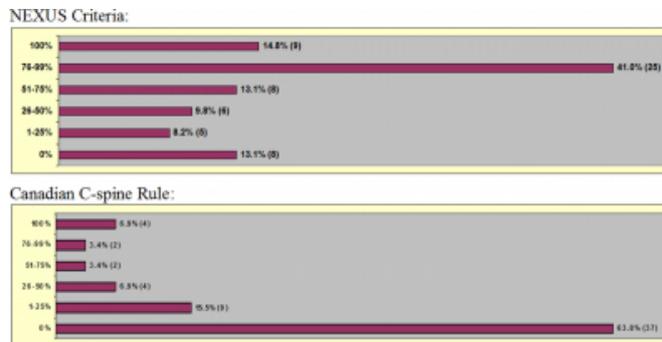
**RESULTS**

A total of 61 Massachusetts emergency physicians responded to our survey. As the invitation was open and meant to be distributed to colleagues, the survey response rate is unknown. Physician respondents worked a mean of 9.6 years since completing their residency. Forty-three physicians (70.5%) worked primarily in the academic emergency department (ED) setting and 18 (29.5%) worked in a community ED. Fifty-five physicians (90.2%) were either board-certified or board-eligible in emergency medicine.

The percentage of time that physicians use NEXUS and CCR are shown in Figure 1.

**Figure 1**

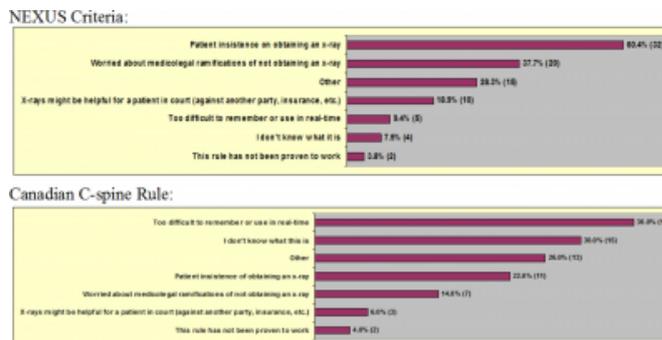
Figure 1: Percentage of time that respondents reported using the clinical decision rules



Thirty-four physicians (55.7%) reported using the NEXUS criteria >75% of the time. Six physicians (9.8%) used CCR >75% of the time. The reasons for not using NEXUS and CCR are demonstrated in Figure 2.

**Figure 2**

Figure 2: Reasons that respondents did not use the clinical decision rules



The most common reasons for not using the NEXUS criteria were patient insistence on obtaining an x-ray (60.4%) and worries about the medico-legal ramifications of not obtaining an x-ray (37.7%). The most common reasons for not using CCR were that the rule is too difficult to use or remember in real time (36.0%) or lack of knowledge about the rule (30.0%). When asked to write down the rule from memory, 21 of 34 (61.8%) respondents who reported using NEXUS >75% of the time reported the criteria correctly. For respondents who reported using CCR >75% of the time, 2 of 6 (33.3%) reported the rule correctly.

**DISCUSSION**

Clinical decision rules aim to simplify and increase the accuracy of a clinician’s diagnostic ability in situations of

complex decision-making, high clinical stakes or where there are opportunities to save without compromising clinical care [3]. CDRs are generally derived with rigorous statistical methodology for both derivation and validation [3]. However, very few rules have actually undergone rigorous impact analysis to determine if they are impacting patient care [4]. Notable exceptions are the NEXUS and Canadian C-spine Rules. Given that they are “competing” rules, multiple comparisons have been performed [56789].

When Stiell, et al prospectively applied NEXUS and CCR to ED patients, they discovered that CCR was more sensitive (99.4% vs 90.7%) and more specific (45.1% vs 36.8%) than NEXUS [5]. This article raised controversy in the literature, and a reply from the NEXUS group accused the Canadian researchers of making a “misclassification error” and, therefore, not applying the rule correctly [8]. Another similar study performed by the Canadians, in which they retrospectively applied the NEXUS criteria to their patients, found the sensitivity of the NEXUS rule to be only 92.7% [6]. A critique of this paper published in the same journal is that the Canadian researchers used surrogate criteria and not the true NEXUS rules [7].

This argument is reminiscent of a prior controversy with previous CDRs published by the Canadian group: the Ottawa Ankle Rules and the Ottawa Knee Rule [1011]. When an external group published an inferior sensitivity while attempting to validate the Ottawa Ankle Rule, Stiell et al accused the authors of not using “the real” Ottawa Ankle Rules [1213]. Similarly, when an external validation of the Ottawa Knee Rule showed inferior sensitivity, the Canadian authors again stated that the problem was that their rule was not applied correctly [14]. The group’s suggestion is that posters and pocket cards should be used to remind clinicians of the rule.

Our study demonstrates that neither of these rules is being used well. Just 62% of physicians who used NEXUS frequently were able to recall the rule by memory, and 33% of physicians who used CCR frequently could recall the rule by memory. The most common error in the NEXUS group was the additional of an age criteria (e.g. respondents reported that radiographs are always necessary for patients age >65) (unpublished data). Such additions of criteria are unlikely to decrease sensitivity of the rule, but can markedly decrease specificity and hence, increase x-ray ordering, a feature that defeats the purpose of having a CDR. Stiell, et al address this issue by providing physicians with posters and

pocket card reminders of the rule [15]. Mower, et al, states: “Ultimately, a decision instrument is of little value if it is so complex that clinicians choose not to use it. NEXUS provides a simple, straightforward instrument that safely allows physicians to select candidates for cervical-spine radiography with a sensitivity that is very close to 100 percent” [8].

Although these CDRs have demonstrated safety and cost-effectiveness, their uptake and barriers to their use are important to determine. A study of Canadian emergency physicians showed that 63.0% used the CCR and that the best predictors of whether a rule would be used was if it was seen during training (OR 2.6), was perceived as an efficient use of time (OR 4.4), and was too much trouble to apply (OR 0.3) [16]. Our study agrees that difficulty with application is a barrier to use, but we also demonstrate that medico-legal concerns and patient insistence of radiography may be additional concerns. These factors may also be country or even region specific. An international study by Graham, et al showed country-specific preferences in the application of the Ottawa Ankle Rules and Ottawa Knee Rule, and U.S. physicians held the least positive attitude towards CDRs [17]. Other suggestions are that physicians may have a low self-efficacy (lack of confidence in their ability to apply a decision rule) or low outcome expectancy (a belief that the decision rule may not make a difference in patient outcomes) [18].

The interpretation of this study must be considered in light of its limitations. This study is limited by its small sample size and unknown response rate. As the e-mail invitation was sent to numerous physicians to then pass on to their colleagues, the number of physicians who received the invitation is unknown. There is also the possibility of selection bias and response bias in such a situation. Finally, this study was limited to Massachusetts and the majority of respondents work in academic EDs. Generalization to other physician populations is not advised without further study.

### CONCLUSION

Several years after publication of the NEXUS and CCR CDRs, there is variable use and interpretation of the rules by emergency physicians in Massachusetts. Furthermore, multiple barriers to their use have been determined. Overcoming incorrect use of CDRs and barriers to their use is fundamental to their successful application; otherwise, their cost-effectiveness or safety may be questionable.

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