



**TITLE: Optimizing the Implementation of Diagnostic Imaging Decision Support Tools: A Review of the Evidence and Guidelines**

**DATE:** 13 July 2010

**CONTEXT AND POLICY ISSUES:**

Ordering of unnecessary or inappropriate imaging examinations may cause harm to patients from medical radiation or false positive results, and may delay diagnosis and treatment.<sup>1,2</sup> It is also an inefficient use of health care resources.<sup>1</sup> Modifying clinicians' test ordering behavior is complex and often requires a multimodal approach to achieve long term changes.<sup>1</sup> Stand-alone decision support tools have been shown to reduce the inappropriate ordering of imaging tests; however, maintaining compliance with guidelines requires continuous education and enforcement.<sup>2</sup> This report will examine the evidence on interventions to improve implementation and utilization of decision support tools for diagnostic imaging.

**RESEARCH QUESTIONS:**

1. What is the evidence regarding mechanisms to optimize the implementation of diagnostic imaging decision support tools?
2. What are the guidelines regarding the implementation of diagnostic imaging decision support tools?

**METHODS:**

A limited literature search was conducted on key health technology assessment resources, including PubMed, The Cochrane Library (Issue 6, 2010), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI (Health Devices Gold), EuroScan, international health technology agencies, and a focused Internet search. The search was limited to English language articles published between January 1, 2005 and June 22, 2010. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies and guidelines. Reference lists were hand searched.

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HTIS reports are organized so that the higher quality evidence is presented first. Therefore, randomized controlled trials are presented first, followed by observational studies.

### **SUMMARY OF FINDINGS:**

From the literature search, one randomized controlled trial<sup>3</sup> and one observational study<sup>4</sup> were identified. No health technology assessment reports, systematic reviews, meta-analyses, controlled clinical trials or guidelines were found that were relevant to the research questions.

#### **Randomized controlled trials**

In a cluster randomized before-and-after trial conducted in Canada, the implementation strategy of the Canadian C-spine decision rule was evaluated.<sup>3</sup> The C-spine rule lists a series of patient characteristics or symptoms, or characteristics of the trauma that can be used to identify patients at higher risk of serious head and neck injury who require cervical radiography. A total of 12 hospitals were matched based on hospital type and current cervical spine X-ray ordering practices for patients with blunt trauma to the head and neck. After an initial 12 months of monitoring cervical spine ordering practices, hospitals were randomized to the intervention (n=6) and control (n=6) groups. In the intervention group, the physicians in the emergency departments agreed to order cervical imaging according to the rule. In addition, the intervention group received an educational component consisting of circulation of relevant manuscripts, pocket cards and posters, and a one hour training session on application of the rule. A mandatory real-time reminder of the rule when requisitioning the imaging was also implemented. Physicians were to indicate which rule criteria were met or list reasons for not following the rule on the imaging requisition. Ordering practices were monitored for another 12 months. Hospitals in the control group received no specific interventions regarding the rule but physicians may have been familiar with the decision rule from conferences, manuscripts, or other means. Patients were followed for 30 days to identify any missed fractures or serious adverse outcomes.<sup>3</sup>

There were three teaching and three community hospitals in the control and intervention groups.<sup>3</sup> A total of 11,824 patients with injury to the cervical spine were seen in the emergency departments over the two year period: 6,895 patients in the intervention hospitals and 4,929 in the control hospitals. Patient characteristics were similar in the before-and-after periods and in the intervention and control groups. The proportion of patients who had cervical spine imaging was reduced by 12.8% (95% CI: 9.2% to 16.3%) after implementing the C-spine rule at the intervention hospitals. Cervical spine imaging increased by 12.5% (95% CI: 7.2% to 18.2%) in the control hospitals ( $p < 0.001$  compared to the intervention sites). At the intervention hospitals, physicians completed the decision rule section of the imaging requisition for 85.7% of patients. In 2.4% of these patients, the physician requested an X-ray against the recommendation of the C-spine rule. No data were presented on the portion of physicians applying the C-spine rule at the control sites. No fractures were missed and no serious adverse outcomes were identified at any of the sites during the follow-up period. The study's authors concluded that an active strategy to implement the C-spine rule reduced the use of cervical spine imaging without any missed injuries or patient morbidity.<sup>3</sup>

## **Observational studies**

A retrospective, uncontrolled before and after study conducted in the US examined clinicians' use of a diagnostic imaging decision support tool.<sup>4</sup> The academic medical centre implemented a web-based radiology order entry system for outpatient diagnostic imaging tests. The decision support tool displayed a nine-point scoring system on the appropriateness of the requested computed tomography (CT), magnetic resonance (MR) or nuclear medicine test to the user, as well as information on the appropriateness of alternative tests. During the early implementation (control) period, no limitations were placed on ordering tests graded as having a low diagnostic yield, and non-clinical support staff were allowed to enter orders for these tests. In the second phase of the implementation (intervention period), tests with a low yield could not be completed by non-clinical staff. Clinicians were required to log into the system to complete the test order and, thereby, were able to access the decision support information. During the control and intervention periods, 42,737 and 76,238 examinations were ordered, respectively. Twenty six percent of exams were entered by clinicians during the control period compared to 54% of exams in the intervention period ( $p < 0.001$ ). In the control period, 5.4% of MR, CT or nuclear medicine tests performed had a low yield score versus 1.9% in the intervention period ( $p < 0.001$ ). The authors concluded that a change in the logic of the order entry and decision support system increased clinicians' use of the system, and reduced the percentage of low yield outpatient CT, MR or nuclear medicine examinations.<sup>4</sup>

## **Limitations**

The generalizability of the findings from the randomized study may have been impacted by the selection of study centres. Seven of the 12 hospitals (three in the intervention and four in the control group) included in the trial had previously participated in a validation study of the C-spine rule, and baseline cervical imaging rates were lower than expected suggesting that physicians may have already modified their behavior.

The observational study lacked a concurrent control group; therefore, it is not possible to assess the impact of other temporal factors on clinicians' use of the order entry and decision support system. No information on the impact on patient outcomes was presented. The study was conducted at a single US academic medical centre which may impact its external validity.

## **CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING:**

There is limited information available to determine optimal methods to increase uptake and utilization of diagnostic imaging decision support tools. In one randomized trial, an education program combined with a mandatory real-time reminder of the decision rule achieved over 80% compliance with the recommended test ordering guidelines. One observational study reported that physicians' use of an order entry and decision support system was increased by placing restrictions on non-clinical staff's access to enter imaging orders.

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**REFERENCES:**

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2. Bairstow PJ, Persaud J, Mendelson R, Nguyen L. Reducing inappropriate diagnostic practice through education and decision support. *Int J Qual Health Care*. 2010 Jun;22(3):194-200.
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**APPENDIX 1: Additional studies of interest**

Bairstow PJ, Persaud J, Mendelson R, Nguyen L. Reducing inappropriate diagnostic practice through education and decision support. *Int J Qual Health Care*. 2010 Jun;22(3):194-200. Abstract available from: <http://intqhc.oxfordjournals.org/cgi/content/abstract/22/3/194>

*See discussion for information on issues related to implementation of decision support tools.*