Practice Corner: Using clinical prediction rules

SCENARIO

On inpatient teaching rounds, we recently discussed the admission of a 45-year-old woman with chest pain. This patient presented to the emergency department after an episode of chest pain lasting approximately 30 minutes. The pain was pleuritic in nature, located on the right side of her chest, and was associated with shortness of breath. The patient reported no palpitations, diaphoresis, nausea, or vomiting. She had no relevant medical history, was taking oral contraceptives, and had no family history of cardiac or thromboembolic disease. Her vital signs, including oxygen saturation, were normal, as were the physical examination results. The working diagnosis was pulmonary embolus (PE), and she was started on intravenous heparin and scheduled for a ventilation-perfusion (V/Q) scan to be done within the next half hour.

After interviewing the patient with a team (2 residents, 3 interns, and 2 medical students) and reviewing the data, I asked the team to individually record their best estimate of the probability that this patient had PE. At first, the team was reluctant, in particular the third-year residents, but with encouragement, all members of the team scribbled down their best estimate. The probabilities were reviewed and were found to range from 5% to 80%.

The importance of accurately determining the pretest probability of disease is highlighted in Figure 1. For our patient, resident 1 estimated the patient's pretest probability of PE as being high (i.e., 80%). This pretest probability combined with a low-probability V/Q scan result (likelihood ratio = 0.4) gives a 61.5% probability of PE (1). This post test probability is not sufficient to either rule in or rule out the diagnosis of PE and would prompt the resident to order further diagnostic tests, such as spiral computed tomography or pulmonary angiography, to better clarify the diagnosis. Resident 2 estimated the patient's pretest probability as being low (i.e., 5%). When combined
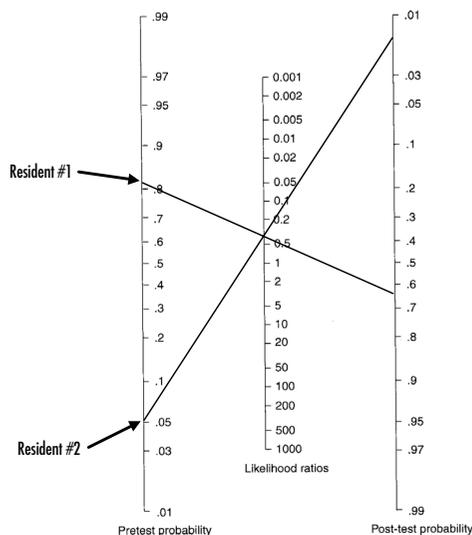

Figure 1. Resident 1 estimates the pretest probability of PE at 80%. This estimate results in a posttest probability of 61.5%, given a low-probability V/Q scan (likelihood ratio = 0.4). Resident 2 estimates the pretest probability of PE at 5% for the same patient. This results in a posttest probability of 2.1%, given a low-probability V/Q scan.

with the same V/Q scan results, a final probability of PE of 2.1% is estimated. Resident 2 would probably stop any further diagnostic workup. Therefore, for the same patient, differing assessments of the pretest probability of a PE by the 2 residents result in very different management strategies.

As a group, we decided it would be useful to see whether we could quickly find valid information about the patient's pretest probability to help us with the diagnostic decision-making process.

SEARCH AND APPRAISAL

Information about the accuracy of diagnostic tests is difficult to find easily and quickly. Even more challenging is trying to find information about pretest probability. Several potential sources could be used to determine pretest probability, including our own clinical expertise, an audit of our practice, and the primary literature.

Clinical prediction rules (CPRs)* have been created to help clinicians arrive at more accurate estimates of pretest probability. A CPR is a tool that quantifies the individual contributions that various components of the history, physical examination, and basic laboratory test results make toward the diagnosis, prognosis, or probable response to a treatment of an individual patient (2). CPRs are most useful when directed at frequent problems for which the stakes are high or cost saving is possible.

CPRs are most useful at the patient's bedside. However, they often require solving complex algorithms or performing tedious calculations to obtain a result. Therefore, many computer-based models have been developed on the Internet and for personal digital assistants (PDAs). Electronic CPRs enable easy calculation of pretest probability and give quick and perhaps more accurate estimates.

A small library of CPRs can be found at the Mount Sinai EBM Web site (http://med.mssm.edu/ebm). These CPRs were chosen by a team of academic general internists for common medical problems and are organized by level of evidence (2), a measure of quality that describes whether the CPR is merely derived (level 4) or validated (levels 2 to 3) or whether an impact analysis of the CPR has been done (level 1). Such key information as the study population and the point of decision making at which the CPR should be applied are a link away (3, 4). CPRs can also be downloaded for PDA devices from this Web site.

APPLYING THE EVIDENCE

In the scenario described above, the team referred to a CPR on the Mount Sinai EBM Web site that was based on information from a study by Wells and colleagues (5) and from the PIOPED study (6). We first noted that the Wells CPR is considered level-3 evidence and that the study population included patients similar to ours. On the first page of the Web site, we found a list of respiratory symptoms and noted that our patient had 2 of these (dyspnea and pleuritic chest

*In *ACP Journal Club, Evidence-Based Medicine, Evidence-Based Nursing,* and *Evidence-Based Mental Health,* clinical prediction rules are referred to as clinical prediction guides.

Probability of Pulmonary Embolism

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Wells, P. S., Ginsberg, J. S., et al. (1998). "Use of a clinical model for safe management of patients with suspected pulmonary embolism." Ann Intern Med **129**(12).

Important CPR Information

Rates of PE According to Pre-Test Probability

CPR Model used to Calculate Pre-test Probability of PE

Respiratory Symptoms

☑ Dyspnea or worsening of chronic dyspnea
☑ Pleuritic chest pain
☐ Chest pain that is nonretrosternal and nonpleuritic
☐ Arterial oxygen saturation < 92% that corrects with oxygen supplementation < 40%
☐ Hemoptysis
☐ Pleural rub

NEXT

Figure 2. Respiratory symptoms.

pain) (Figure 2). 3 subsequent screens asked the team to record whether the patient had additional signs or symptoms and any of 8 listed risk factors for PE. We were also asked to consider whether an alternate diagnosis could be less likely than PE in this patient. Clicking the "calculate" button on this last screen (Figure 3) produced an estimate of the patient's pretest probability (3.4%, 95% CI 2.5 to 5.0) and a posttest probability of PE of 1.4% (CI 1.0 to 2.0) following her low-probability V/Q scan. With this low posttest probability, the team felt comfortable ruling out PE.

Calculate Probability of PE

Is the alternative diagnosis (choose one):
○ As likely or more likely than PE.
● Less likely than PE.

Result of VQ Scan (choose one):
○ Normal
● Low Probability
○ Intermediate Probability
○ High Probability

Click to Calculate Probability

Pre-test Probability of PE: `Low:3.4%(2.5-5%)`

Post-test Probability of PE: `1.4%(1-2%)`

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Figure 3. Alternative diagnosis, V/Q scan result, pretest probability, and posttest probability.

Using the CPR and our patient's unique clinical circumstances, the calculation process took less than 1 minute. Our team, however, also spent several minutes reviewing the links for the level of evidence, population, and clinical decision model on the Web site.

EVALUATING THE PROCESS

Medicine is still an art, and all clinicians have their own threshold of uncertainty that they are willing to accept before making a diagnostic or therapeutic intervention. CPRs are only tools in this process and may serve to provide an objective standard by which clinicians can better quantify the pretest probability of disease.

Several Internet sites have both browser-based and PDA-based CPR calculators (Table). These sites help us to practice evidence-based medicine in real time. In this scenario, we were able to find and use a CPR in less than 2 minutes. However, few of these sites identify the level of evidence of a particular CPR or the population from which the rule was derived. Both types of information are necessary to apply the rule safely and in the correct setting.

Clinical prediction rule Web sites

Name	Web site	Platform
InfoRetriever	www.InfoPOEMs.com	Internet PDA
MedRules	pbrain.hypermart.net/medrules.html	PDA
The Medical Algorithms Project	www.medal.org	MSExcel 97
Mount Sinai EBM Web site	med.mssm.edu/ebm	Internet PDA
Clinical Decision Rules	www.ohri.ca/programs/ clinical epidemiology/ OHDEC/clinical.asp	Internet

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2. **McGinn TG, Guyatt GH, Wyer PC, et al.** Users' guides to the medical literature. XXII: how to use articles about clinical decision rules. Evidence-Based Medicine Working Group. JAMA. 2000;284:79-84.
3. **Wasson JH, Sox HC, Neff RK, Goldman L.** Clinical prediction rules. Applications and methodological standards. N Engl J Med. 1985;313:793-9.
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6. **Worsley DF, Alavi A.** Comprehensive analysis of the results of the PIOPED Study. Prospective Investigation of Pulmonary Embolism Diagnosis Study. J Nucl Med. 1995;36:2380-7.