

Deriving and using decision rules-example of a clinical decision rule for triage of children under 5 years of age with organophosphate or carbamate insecticide exposure.

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What are Decision Rules? They are “diagnostic” or screening tests that use multiple clinical components to determine if a patient is in a high or low risk category for a disease or specific risk. An example is the WHO decision rule for treating pneumonia in children without an x-ray. Some clinical decision rules are used to identify patients who don't need tests or treatment (low risk) and some are used to identify those who are at some risk for complications or can be treated without further testing (high risk). When constructing these rules the goal is high discrimination with minimum tolerance for adverse outcome (failing to identify high risk individuals). The components included in the test (clinical signs or symptoms or lab tests) should make sense for the disease in question, objective and be easy to determine (e.g., tachypnea for pneumonia). The rule that puts together the components should be easy to remember. A rule that puts a patient in or out of risk is better than coming up with several risk categories (i.e., low, middle and high risk) with a different response for each group.

How is a Decision Rule derived? First, clinicians determine if there is a need for a decision rule. Is this a problem for which identifying high risk or low risk patients could save time or money or use fewer resources? For example, can we safely save referrals (use less resources) of children after exposure to OP/C based on an exam based rule? Can early exam accurately predict the future? Second those deriving rules consider what the likely findings are that will be present in those who have risk and absent in those who don't. Then they plan to prospectively collect clinical information on all patients to see how the predicted findings actually sort high risk from low risk-and which are best without overlap. This can involve a fancy statistical analysis called recursive partitioning (sequential grouping) or logistic regression, discriminant function. But in essence recursive partitioning is just taking the finding that best divides the group into high and low risk, then the finding that best divides those that remain in the group to be identified for the others, etc.. This can be done by hand in some contexts. Those few steps identify the findings that if present, indicate risk or absence of risk. The presence or absence of these findings becomes the decision rule in its simplest form: if they are present, treat, if not, don't treat.

Once a rule is derived it must be tested, refined for better accuracy and validated in another context (to see if it is applicable to patients everywhere or just ones at a certain institution that receives a certain kind of filtered patient). Part of the testing is making sure that all who use the test can identify the findings of interest uniformly-e.g., does everyone who looks at a pupil agree what small means? Finally when a successful rule is propagated for use it must be evaluated to see if it is being used broadly as intended and if it really guides treatment in a way that saves resources. Rules can't always be derived. The WHO has spend much effort to find a rule that predicts risk of strep throat (to guide resource appropriate treatment to prevent rheumatic fever) but has been unable to develop a clinical based rule.

What did we do to address the question of OP/C exposed children? We went to Ain Shams University Poison Control Centre—a poison treatment center for all ages in Cairo, Egypt with its own ED and 31 inpatient beds, serving 25,555 patients in 2004 (5,277 age < 5 y). With parental permission, we prospectively collected data on patients aged 2 mo to 5 yr arriving within 2 hours of OP or C exposure and without prior treatment with atropine, albuterol, epinephrine or obidoxime. Data included historic and exam based signs and symptoms (cough, vomit, persistent vomiting, diarrhea, sweating, pallor, respiratory rate, heart rate, pupil size, wheezing, respiratory effort, GCS score, lethargy score, among others). In a subset of cases two examiners evaluated the findings to see if they were coding positives and negatives the same. We also collected data on findings such as need for atropine or obidoxime or hypoxia or for ICU or death to categorize the outcome severity of the exposure. It took 18 months to get 95 patients who met the entry criteria (another 97 did not meet eligibility criteria due to late presentation or pretreatment and 7 refused). Importantly we kept track of those who came but did not meet the criteria, especially those whose parents refused, so that we could see if we were deriving the rule using a biased subset. Of the 95 patients there were 30 with a minimally symptomatic, non resource-requiring course and 65 whose treatment required resources (40 requiring atropine only, and 25 with a more severe course all requiring pralidoxime, including 21 in the ICU, of which 4 died). Looking at the findings in each group by manual recursive partitioning, in this case by simple cross tabulation, two easily identified features stood out as differentiating moderate or severely symptomatic patients from minimally symptomatic patients. Pinpoint pupil alone identified 63/65 moderate or severe patients while identifying 5/30 minimal patients (97% sensitivity, 83% specificity). Pinpoint pupil or diarrhea identified 65/65 moderate or severe courses while identifying 7/30 minimal (100% sensitivity, 77% specificity). From this work we derived the rule: if pinpoint pupils or diarrhea is noted at presentation within 2 hours of presumed ingestion of a carbamate or organophosphate by a child, a resource-requiring course may ensue and the patient should be evaluated at an institution that can treat complications. If neither of these features is present, a complicated course is very unlikely and the child may be observed at home. Use of this rule could have saved referral in 23/95 (24%) of patients in our setting. But, since the rule was derived retrospectively from prospectively collected data, it needs to be tested prospectively, refined and then tested in another environment before we can be sure it is safe for wide use and would save resources to the same degree as predicted in our experience.

See: Stiell IG, Wells GA: Methodologic standards for the development of clinical decision rules in emergency medicine. *Ann Emerg Med.* 1999; 33: 437-47