Clinical Prediction Rules and Pediatric Infectious Diseases

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Abstract: Clinical prediction rules (CPR) are tools including appropriately weighted clinical aspects (history, physical examination and/or complementary tests) showing the odds for a specific diagnosis or prognosis. Their development includes a complex and strict process to achieve the scientific strength which supports use in clinical settings. Although CPR may be developed for almost any clinical situation, they are particularly useful in complex decision making, high-risk situations and for health cost reduction. Most CPR in pediatrics are devoted to infectious diseases, but only a few of them are used in daily practice. Reluctance in using them may be related to the most pediatrician’s expectation of 100% sensitivity, when only a few CPR have sensitivity >90%. It is important to take into account that even a less-than-perfect CPR may be more sensitive than the physician’s clinical judgment alone.

Key Words: clinical prediction rule, predictive value of tests, decision support techniques

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Making patient diagnosis and prognosis are everyday medical activities. The clinical experience stimulates the healthcare provider’s intuition to select which findings (from history, physical examination and/or simple tests) must be used to diagnose a disease or to predict patient’s outcome. Despite intuition being very precise, sometimes it can be wrong. This lack of certainty, which is closely linked to the individual healthcare provider’s capacity and experience, has led to the search of useful tools in the definition of diagnosis and prognosis. These tools are called clinical prediction rules (CPR), and they are intended to help doctors identify which variables should be searched for by evaluating a patient.1 It seems that only a few of them are used in everyday practice. Those authors report that the quality of CPR in pediatrics is less than that in adults because of particular obstacles of this kind of research in pediatric patients (great interobserver variability in history and physical examination, small number of children with the disorder of interest, rare outcomes). This finding could explain the reluctance to use CPR in this age group.2

Pediatricians have to decide daily if a patient should receive antibiotics or not in different situations (meningitis, pneumonia, pharyngitis), based on their experience and clinical and laboratory findings. Despite the fact that CPR can weigh these findings and help in more accurate decision making, they usually prefer to give antibiotics almost always, which leads to the increase of inappropriate antibiotic prescription.3 It is probable that CPR can help guide a more appropriate antibiotic prescription in several situations, such as meningitis, pneumonia and pharyngitis.4–10 Despite only few patients having bacterial meningitis, children with cerebral spinal fluid (CSF) pleocytosis are usually hospitalized and treated with antibiotics. Nigrovic et al10 developed a CPR named Bacterial Meningitis Score (BMS) that identifies children at low risk of bacterial meningitis, based on very simple criteria: CSF Gram stain, CSF absolute neutrophil count, CSF protein, peripheral blood absolute neutrophil count and a history of seizure. A wide validation of this score showed that the BMS accurately identified children with pleocytosis.

CPR IN PEDIATRIC INFECTIOUS DISEASES

In a recent review, Maguie et al11 identified 101 CPR for children, most of them devoted to infectious diseases. Surprisingly, it seems that only a few of them are used in everyday practice. Those authors report that although CPR may be developed for almost any clinical situation, they are particularly useful in complex decision making, high-risk situations and in situations that allow health cost reduction.12 For example, the pneumonia severity index is used to decide if an adult patient with community-acquired pneumonia needs to be hospitalized, the Pediatric Risk of Mortality III categorizes children according to severity to receive intensive care and the Ottawa ankle rules are devoted to substantial saving in health cost.

WHAT ARE CPR?

CPR are scores that include appropriately weighted clinical findings (history, physical examination and/or complementary tests) showing the odds for a specific condition being present or a precise outcome happens. They quantify the relative importance of particular findings when evaluating an individual patient.1

HOW ARE CPR DEVELOPED?

Although CPR must be very simple to be useful and feasible in everyday clinical practice, the development of CPR includes a complex and strict process to achieve the scientific strength necessary to support their widespread use. In the beginning, predictors must be identified and weighted using appropriate statistics (logistic regression, recursive partition analysis and so on) with blinded assessment of outcomes. The final product will be a score obtained from adding each adjusted component. Afterward, the CPR must be validated in different populations and scenarios. This procedure is of paramount importance to limit the effect of possible selection bias when the CPR was created and to estimate the CPR performance in real-life settings. After it had been prospectively and broadly validated, the CPR must be transformed into a clinical decision rule. The necessary “impact analysis” means to prospectively demonstrate that the physician’s decision will be improved by using the CPR. The only way to assess this issue accurately is by conducting randomized controlled trials (the patients are randomly allocated in 2 subgroups: one with the CPR use and the other without the CPR use), as “before-after” and “on-off” designs are weaker alternatives for impact analysis.4 Moreover, it is necessary to test its feasibility, its cost-effectiveness (if this is not the outcome) and if its use imposes new risks to the patients.

USEFULNESS OF CPR

Although CPR may be developed for almost any clinical situation, they are particularly useful in complex decision making, high-risk situations and in situations that allow health cost reduction.12 For example, the pneumonia severity index is used to decide if an adult patient with community-acquired pneumonia needs to be hospitalized, the Pediatric Risk of Mortality III categorizes children according to severity to receive intensive care and the Ottawa ankle rules are devoted to substantial saving in health cost.

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who do not need antibiotics (negative predictive value = 99.9%); this means that BMS could have reduced antibiotic use in 52% of children participating in that research.13 Most of the pediatric patients with pneumonia usually receive antibiotics despite more than half of them have sole or combined viral infections.14 The Bacterial Pneumonia Score accurately identifies children with pneumonia who do not require antibiotics (negative predictive value = 99.9%) based on simple and accessible elements: age, fever, peripheral blood absolute neutrophil count, band and chest radiograph findings.15 By using this score, 55.6% of children with pneumonia did not use antibiotics, even in an ambulatory setting.15

Noteworthy, the practice guideline for the management of infants and children 0 to 36 months of age with fever without source, published in 1998,16 has been widely accepted17 and the possible predictors used in this guideline were first identified in 1975.18 As investigation advances, the guideline has been updated.19 Unfortunately, the same scientific data that can add improvements in clinical practice can contribute to the confusion. The clinical guidelines for the management of community-acquired pneumonia in childhood issued by the Infectious Diseases Society of America,20 British Thoracic Society21 and World Health Organization22 show quite different recommendation regarding the use of antibiotics. Those are examples of clinical decision rules derived from CPR. However, they were not only based on CPR as expert opinions were also taken into account.

Reluctance in using CPR may be related to the expectation of 100% sensitivity that most pediatricians have, when only a few CPR have sensitivity >90%. It is important to take into account that even a less-than-perfect CPR may be more sensitive than the physician’s clinical judgment alone.4 The acceptable sensitivity level of a CPR is whatever over clinical judgment alone (ie, if clinical judgment has 65% sensitivity, 88% sensitivity for a CPR will be nice). If CPR are considered as powerful decision-making aids instead of inflexible rules, they may be more easily accepted.

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