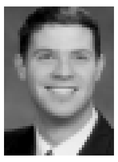
Clinical Decision-Support Systems in Pediatrics

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Clinical decision-support systems (CDSS) are generally defined as any computer program designed to help health professionals make clinical decisions.[1] Although we still do not have anything resembling Dr McCoy's famous tricorder on Star Trek, there has been an explosion of useful CDSS in recent years, and an increasing number are relevant to the care of children.

The concept of computerized decision-support in pediatrics is not new. As far back as 1961, Warner described a mathematical approach for the diagnosis of congenital heart disease.[2] In this study, long before the advent of echocardiography, data were drawn from 1,035 patients referred for cardiac catheterization. Given multiple clinical findings, a matrix of 33 different congenital heart diseases and 50 associated clinical findings was used to calculate the probability of a specific diagnosis. The diagnostic accuracy of this system matched that of 3 pediatric cardiologists.

Although, historically, CDSS primarily were focused on diagnostic recommendations, pediatric decision-support can be provided by any computer system that deals with clinical data and medical knowledge to help deliver patient-specific advice.[3] Laboratory systems that flag abnormal values, immunization registries that issue vaccination reminders, and automated pediatric electrocardiograph (ECG) interpretation are just a few examples of CDSS in common use today.

Clinical decision-support systems can be categorized by type (simple rule-based alerts vs more complex methods like neural networking and Bayesian statistics), domain (problem-focused vs general diagnostic support), or access (handheld computer vs Web-based vs integrated within an electronic medical record [EMR]). For the purposes of clarity, we will look at a few examples categorized by means of access.

Decision-Support Tools on Handheld Computers

While the house officer of yesterday routinely carried a notebook to record pearls of wisdom, the resident of today typically carries a Palm™ or PocketPC™ handheld. Widely referred to as a "peripheral brain," the personal digital assistant (PDA) is well-suited for decision-support tools since it always is accessible at the clinician's side. However, the complexity of tools available on the handheld generally is restricted by the hardware limitations inherent to this platform, including the cumbersome nature of entering data. Patient-specific information is, therefore, generally focused on one particular problem or diagnosis.

An example of a decision-support tool on the handheld is ePocrates Rx™, a drug reference tool with pediatric dosing guidelines (available at http://www.epocrates.com). A recent survey of pediatricians conducted by ePocrates suggested significant positive impact on quality of care from the use of PDAs in pediatric practice. Seventy-five percent of survey respondents used their PDA more than 6 times per day, most often to access drug information (96%). Most significantly, 80% of respondents said they practice safer medicine using a PDA, while nearly two thirds said that using their PDA had decreased the number of potential medical errors. Unbiased reviews of other pediatric software available for handhelds can be found at Pediatrics on Hand (http://www.pediatricsonhand. com/), a useful Web site run by our own newsletter editor, David C. Stockwell, MD.

Decision-Support Tools on the Internet

The exponential growth of the Internet has made deployment of decision-support systems much easier, particularly since a server-based system can access virtually unlimited memory and database resources. Here we consider 2 different tools that represent the full gamut of clinical decision-support tools, from the most problem-focused to the most general diagnostic support.

BiliTool (http://bilitool.evidencebasedcare.org/) is an online decision-support system built to facilitate hyperbilirubinemia risk stratification in newborns. Based on the recently published 2004 AAP guidelines, it stratifies patients into risk categories based on the age of the patient at time of blood sampling (in hours) and the total bilirubin level.[4] Although the now-familiar Bhutani nomogram was first published in 1999, it required manual calculation of the baby's age and plotting of the bilirubin level, a process prone to human error. Since BiliTool will perform this calculation automatically, it is a fine example of how a decision support tool can both facilitate adherence to already existing clinical guidelines and potentially reduce human errors in the process.

On the other end of the spectrum, ISABEL (http://www.isabel.org.uk/) is a diagnosis reminder system designed exclusively for use in pediatrics. It was developed with the help of the parents of an English girl who nearly died after doctors failed, at multiple visits, to diagnose necrotizing fasciitis, a rare but known complication of varicella. Results from an initial performance evaluation suggested that ISABEL showed more than 90% accuracy in producing the final diagnosis for a variety of real as well as hypothetical case scenarios.[5] Although such tools can be very helpful in challenging cases, as well as useful for educational purposes, the need to enter patient-specific data generally prevents it from being useful for *every* patient.

Decision-Support in the Electronic Medical Record

From a process perspective, the problem with the previously described systems is that they require clinicians to actively seek out the tool and enter relevant patient data, a potentially time-consuming task in an already busy day. The future of clinical decision-support systems clearly lies in tight integration with the EMR, so that the very concept of a decision-support *system* fades away. When integrated with a robust EMR, decision-support can be tailored much more closely to individual patient needs since it does not require duplicate data entry. Additionally, when combined with computerized physician order entry (CPOE), the decision can be affected at the time of entry. Ultimately, automated decision-support should take place in a transparent manner that is integrated with the clinical workflow.

One example of such an effort was the development of a pediatric anti-infective decision-support system program that was integrated into the hospital information system in Utah. The authors concluded that use of the tool in a pediatric intensive care unit (PICU) was considered beneficial to patient care by the clinicians, reduced the rates of erroneous drug orders, improved therapeutic dosage targets, and was associated with decreased costs per patient.[6]

The increasing use of computers in health care is being driven not only by the need to manage large amounts of information, but also by the desire to make evidence-based decisions, standardize care, and prevent medical errors. There is accumulating evidence to prove that clinical decision-support systems improve health care processes as well as patient outcomes.[7] It may not be too long before handhelds with wireless links to the EMR will become as useful as Dr McCoy's tricorder!

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