TABLE 3-2 WELLS CLINICAL PREDICTION RULE FOR PULMONARY EMBOLISM

Clinical Feature	Points
Clinical signs of deep vein thrombosis	3
Alternative diagnosis is less likely than pulmonary embolism	3
Heart rate >100 beats/min	1.5
Immobilization ≥3 days or surgery in previous 4 weeks	1.5
History of deep vein thrombosis or pulmonary embolism	1.5
Hemoptysis	1
Malignancy (with treatment within 6 months) or palliative	1
Interpretation	
Score >6.0	High
Score 2.0–6.0	Intermediate
Score <2.0	Low

separate from the one used to develop the model cannot be overstated. An unvalidated prediction model should be viewed with the skepticism appropriate for any new drug or medical device that has not had rigorous clinical trial testing.

When statistical models have been compared directly with expert clinicians, they have been found to be more consistent, as would be expected, but not significantly more accurate. Their biggest promise, then, may be in helping less-experienced clinicians identify critical discriminating patient characteristics and become more accurate in their predictions.

FORMAL DECISION SUPPORT TOOLS

DECISION SUPPORT SYSTEMS

Over the last 40 years, many attempts have been made to develop computer systems to aid clinical decision-making and patient management. Conceptually attractive because computers offer ready access to the vast information available to today's physicians, they may also support management decisions by making accurate predictions of outcome, simulating the whole decision process, or providing algorithmic guidance. Computer-based predictions using Bayesian or statistical regression models inform a clinical decision but do not actually reach a "conclusion" or "recommendation." Artificial intelligence systems attempt to simulate or replace human reasoning with a computer-based analogue. To date, such approaches have achieved only limited success. Reminder or protocol-directed systems do not make predictions but use existing algorithms, such as guidelines, to guide clinical practice. In general, however, decision support systems have had little impact on practice. Reminder systems, although not yet in widespread use, have shown the most promise, particularly in correcting drug dosing and promoting adherence to guidelines. Checklists, as used by pilots for example, have garnered recent support as an approach to avoid or reduce errors.

DECISION ANALYSIS

Compared with the decision support methods discussed above, decision analysis represents a prescriptive approach to decision making in the face of uncertainty. Its principal application is in complex decisions that involve substantial risk, abundant uncertainty, trade-offs in the outcomes emphasizing a role for preferences, or absence of evidence due to an idiosyncratic feature. For a public health example, Fig. 3-3 displays a decision tree to evaluate strategies for screening for HIV infection. Infected individuals who are unaware of their illness cause up to 20,000 new cases of HIV infection annually in the United States, and about 40% of HIV-positive patients progress to AIDS within a year of the initial diagnosis because of delayed diagnosis. Early identification offers the opportunity to prevent progression to AIDS through CD4 count and viral load monitoring and combination antiretroviral therapy and to reduce spread by reducing risky injection or sexual behaviors.

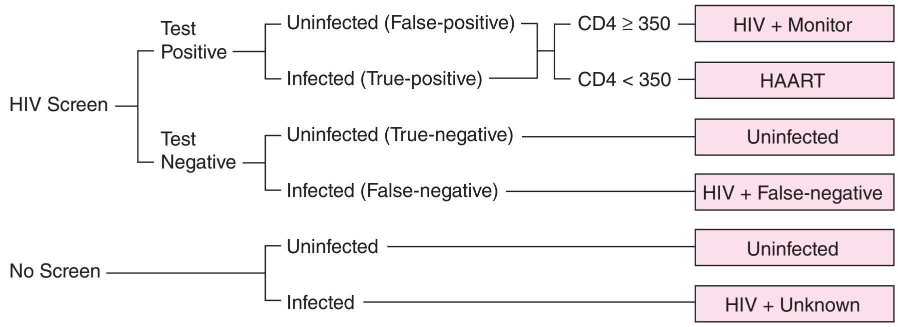

FIGURE 3-3 Basic structure of decision model used to evaluate strategies for screening for HIV in the general population. HAART, highly active antiretroviral therapy. *(Provided courtesy of G. Sanders, with permission.)*

In 2003, the Centers for Disease Control and Prevention (CDC) proposed that routine universal HIV testing should be incorporated into standard adult medical care and, in part, cited a decision analysis model comparing HIV screening with usual care. Assuming a 1% prevalence of unidentified HIV infection in the population, routine screening of a cohort of 43-year-old men and women increased life expectancy by 5.5 days and lifetime costs by $194 per person screened, yielding an incremental cost-effectiveness ratio for screening versus usual care of $15,078 per quality-adjusted life-year (the additional cost to society to increase population health by 1 year of perfect health). Factors that influenced the results included assumptions about the effectiveness of behavior modification on subsequent sexual behavior, the benefits of early therapy for HIV infection, and the prevalence and incidence of HIV infection in the population targeted. This model, which required over 75 separate data points, provided novel insights into a public health problem in the absence of a randomized clinical trial and helped weigh the pros and cons of such a health policy recommendation. Although such models have been developed for selected clinical problems, their benefit and application to individual real-time clinical management have yet to be demonstrated.

DIAGNOSIS AS AN ELEMENT OF QUALITY OF CARE

High-quality medical care begins with accurate diagnosis. Recently, diagnostic errors have been re-envisioned: the old view was that they were caused by a lack of sufficient skill of an individual clinician; the new view is that they represent a quality of care patient-safety problem traceable to breakdowns in the health care system. Whether this conceptual shift will lead to new ways to improve diagnosis is uncertain. An annual rate of diagnostic errors of 10–15%, possibly leading to 40,000 deaths in the United States, is commonly cited, but these figures are imprecise.

Solutions to the "diagnostic errors as a system of care problem" have focused on system-level approaches, such as decision support and other tools integrated into electronic medical records. The use of checklists has been proposed as a means of reducing some of the cognitive errors discussed earlier in the chapter, such as premature closure. Although checklists have been shown to be useful in certain medical contexts, such as operating rooms and intensive care units, their value in preventing diagnostic errors that lead to patient adverse events remains to be shown.

EVIDENCE-BASED MEDICINE

Clinical medicine is defined traditionally as a practice combining medical knowledge (including scientific evidence), intuition, and judgment in the care of patients (Chap. 1). EBM updates this construct by placing much greater emphasis on the processes by which clinicians gain knowledge of the most up-to-date and relevant clinical research