PSNet
PATIENT SAFETY NETWORK

Clinical Decision Support Systems

March 15, 2025
Clinical Decision Support Systems. PSNet [internet]. 2019.
https://psnet.ahrq.gov/primer/clinical-decision-support-systems

PSNet primers are regularly reviewed and updated by the UC Davis PSNet Editorial Team to ensure that they reflect current research and practice in the patient safety field. Last reviewed in 2025.

Background

The promised benefits of health information technology rest in large part on the ability of these systems to use patient-specific data to provide personalized recommendations for care. Clinical decision support systems (CDSS) —defined as any system designed to improve clinical decision-making related to diagnostic or therapeutic processes of care—were initially developed more than 40 years ago, and they have become increasingly sophisticated over time. Clinical decision support systems use specific parameters (such as diagnoses, laboratory results, medication choices, or complex combinations of clinical data) to provide information or recommendations directly relevant to a specific patient encounter at the point of care. The federal HITECH Act of 2009 incentivized health care organizations to implement health information technology, and it included decision support systems as one of its criteria for certifying electronic health record systems. As a result, by 2017 more than 90% of hospitals and 80% of clinics had implemented electronic health records (EHRs) with some form of clinical decision support.

Clinical decision support systems address activities ranging from the selection of medications (e.g., the optimal antibiotic choice given specific microbiologic data) or diagnostic tests (e.g., the best blood test to evaluate a patient with possible pulmonary embolism) to detailed support for optimal drug dosing and support for resolving diagnostic dilemmas. CDSS are usually integrated into computerized order entry systems, with the goal of helping prevent medication prescribing errors and other types of errors. Typical CDSS suggest default values for drug doses, routes of administration, and frequency, and offer more sophisticated drug safety features such as checking for drug allergies or drug–drug interactions. Modern CDSS prevent both errors of commission (e.g., ordering a drug in excessive doses or a drug to which the patient has a known allergy) and errors of omission (e.g., failing to order prophylaxis against deep venous thrombosis in a patient who underwent joint replacement surgery). Though most commonly encountered in medication ordering, CDSS are also increasingly being deployed to support other patient care tasks as well. For example, CDSS have been used to address overuse by improving adherence to guidelines for

diagnostic imaging; identifying hospitalized patients at high risk of deterioration by analyzing changes in vital signs over time; and improving diagnostic accuracy by providing symptom-specific guidance on diagnostic evaluations.

Evidence of Effectiveness

Decision support systems are effective at improving medication safety in both inpatient and outpatient settings. Multiple reviews have found that computerized provider order entry (CPOE) systems with integrated CDSS reliably prevent prescribing errors (although current systems are not effective at preventing errors at other stages of the medication use process and therefore may not reduce overall adverse drug event rates). CDSS are also being used to augment clinicians' skills in other areas—such as diagnostic accuracy—but less evidence currently supports these applications.

As CDSS have become more widespread, understanding of their limitations and potential unintended consequences has evolved as well. Excessive warnings or poorly targeted reminders can easily lead to alert fatigue for clinicians, diminishing the effectiveness of CDSS. These issues are discussed in more detail in the Alert Fatigue and Computerized Provider Order Entry Primers.

Current Context

Decision support systems were initially designed to be used by clinicians at the point of care, but they are now being implemented for a broader range of users. Clinical decision support systems are increasingly being used to provide support for interdisciplinary teams—for example, in the hospital setting, CDSS can calculate an individual patient's risk of readmission based on clinical and demographic factors and suggest appropriate postdischarge resources to care coordination staff. Efforts are also underway to include patients in the development, implementation, and evaluation of CDSS. Patient-centered clinical decision support (PCCDS) refers to decision support systems that support individual patients, caregivers, and health care teams in health-related decisions and actions by leveraging patient-specific information (e.g., patient-generated health data) and patient-centered outcomes research findings.

Most existing decision support systems were designed using standard computer programming techniques, which (in a general sense) consist of explicit rules based on standardized inputs and outputs. For example, designing a decision support system that warns a clinician not to prescribe a medication to which the patient has a documented allergy is a relatively straightforward process. These algorithms are increasingly being replaced by ones derived by much more powerful and sophisticated methods. The advent of advanced analytic methodologies for large, complex data sets and the development of machine learning techniques—where computers process large amounts of data to learn from examples, rather than being preprogrammed with rules based on human inputs—will likely lead to the development of increasingly powerful and sophisticated CDSS. These artificial intelligence approaches have tremendous potential for transforming diagnosis and therapy, and early applications have been very promising. However, there are many potential barriers to integrating artificial intelligence into routine health care. Two recent commentaries on machine learning in medicine and artificial intelligence–based decision support discuss the benefits, limitations, and risks of widespread use of these approaches. Although these innovative techniques hold immense promise, as the commentators note, acceptance of artificial intelligence–based

CDSS will require transparency around the methods used to develop recommendations and rigorous evaluation of new programs to ensure they lead to equitable improvement in patient outcomes.