Community Preventive Services Task Force

Heart Disease and Stroke Prevention: Clinical Decision-Support Systems (CDSS)

Task Force Finding and Rationale Statement

Table of Contents

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Intervention Definition

Clinical decision-support systems (CDSS) are computer-based information systems designed to assist healthcare providers in implementing clinical guidelines at the point of care. CDSS use patient data to provide tailored patient assessments and evidence-based treatment recommendations for healthcare providers to consider. Patient information is entered manually, or received automatically through an Electronic Health Record (EHR) system. CDSS for cardiovascular disease prevention (CVD) include one or more of the following.

- Reminders for overdue CVD preventive services including screening for CVD risk factors such as high blood pressure, diabetes, and high cholesterol
- Assessments of patients' risk for developing CVD based on their history, symptoms, and clinical test results
- Recommendations for evidence-based treatments to prevent CVD, including intensification of treatment
- Recommendations for health behavior changes to discuss with patients such as quitting smoking, increasing physical activity, and reducing excessive salt intake
- Alerts when indicators for CVD risk factors are not at goal

CDSS are often incorporated within EHR systems and integrated with other computer-based functions that offer patient-care summary reports, feedback on quality indicators, and benchmarking. Knowledge management systems providing access to scientific literature and strategies for CVD prevention may also be linked with CDSS.

Task Force Finding (April 2013)

The Community Preventive Services Task Force recommends clinical decision-support systems (CDSS) for prevention of cardiovascular disease (CVD) based on sufficient evidence of effectiveness in improving screening for CVD risk factors and practices for CVD-related preventive care services, clinical tests, and treatments.

Most of the available evidence is from studies on the effectiveness of CDSS when implemented alone in the healthcare system rather than as part of a coordinated service delivery effort to address barriers at the patient, provider, organizational, and community levels. More evidence is needed from implementation of CDSS as one part of a comprehensive service delivery system designed to improve outcomes for CVD risk factors and reduce CVD-related morbidity and mortality..

Rationale

Basis of Finding

The Task Force finding is based on evidence from 45 studies evaluating the effectiveness of CDSS for CVD prevention. The studies were identified from a broad systematic review (Bright et al. 2012, search period January 1976-January 2011) that examined the effectiveness of CDSS in improving quality of care and clinical outcomes for a variety of conditions (e.g., CVD prevention, cancer screening, immunization, antenatal care) and an updated search for newer CVD prevention-focused studies (search period January 2011- October 2012).

The finding of sufficient evidence of effectiveness is based on modest improvements in quality-of-care outcomes (i.e., provider practices) for CVD prevention, inconsistent findings for CVD risk factor measures, and the potential for larger improvements when CDSS is combined with other intervention components to overcome multiple healthcare system barriers.

Results from studies aimed at CVD prevention found use of CDSS led to modest improvements for three quality-of-care outcomes when compared to usual care. These outcomes are comprised of evaluations of provider practices based on U.S. Preventive Services Task Force (USPSTF) [www.uspreventiveservicestaskforce.org/index.html] recommendations for preventive services and clinical guidelines for management of CVD risk factors (Table).

1. CDSS-recommended screening and other preventive care services completed or ordered by providers improved by a median of 3.8 percentage points. This included USPSTF-recommended practices for identifying CVD risk factors such as screening for high blood pressure [www.uspreventiveservicestaskforce.org/uspstf/uspshype.htm], lipid disorders [www.uspreventiveservicestaskforce.org/uspstf/uspschol.htm], diabetes [www.uspreventiveservicestaskforce.org/uspstf/uspsdiab.htm], and smoking [www.uspreventiveservicestaskforce.org/uspstf/uspstbac2.htm]; and for preventive care such as aspirin [www.uspreventiveservicestaskforce.org/uspstf/uspsasmi.htm] and counseling for diet and physical activity.
2. CDSS-recommended clinical tests completed or ordered by providers increased by a median of 4.0 percentage points. This assessment included clinical tests recommended through evidence-based guidelines and protocols for management of high blood pressure, high cholesterol, or diabetes. For example, the American Diabetes Association recommends hemoglobin A1C tests for patients with diabetes who have not been tested within the past 6 months, and a CDSS would alert physicians to order such a test when appropriate.
3. CDSS-recommended treatments prescribed by providers improved by a median of 2.0 percentage points. Studies evaluated treatments for high blood pressure, high cholesterol, diabetes, and smoking cessation that were included in evidence-based guidelines for management of these CVD risk factors. An example of this would be a CDSS recommendation to start medication for a patient diagnosed with high blood pressure or intensify treatment for a patient who is not responding to current treatment.

Effect estimates from the existing systematic review (Bright et al. 2012) that evaluated quality-of-care outcomes for any risk factor or disorder were found to be more robust (Table).

Clinical Decision-Support Systems for CVD Prevention: Quality-of-Care Outcomes

Quality-of-Care Outcome	CVD studies* (Jan. 1976 – Oct. 2012)	Bright et al. 2012** (Jan. 1976 – Jan. 2011)
CDSS-Recommended Screening and Other Preventive Care Services Completed or Ordered	Median: increase of 3.8 percentage points[A] (IQI: -0.08 to 10.6) 17 studies (19 study arms) 5 additional studies showed improvements	OR: 1.42 (95% CI: 1.27, 1.58) 25 studies (37 arms)

Quality-of-Care Outcome	CVD studies* (Jan. 1976 – Oct. 2012)	Bright et al. 2012** (Jan. 1976 – Jan. 2011)
CDSS-Recommended Clinical Tests Completed or Ordered	Median: increase of 4.0 percentage points[A] (IQI: 0.7 to 7.0) 7 studies (7 arms) 2 additional studies showed improvements	OR: 1.72 (95% CI: 1.47, 2.00) 20 studies (26 arms)
CDSS-Recommended Treatments Prescribed	Median: increase of 2.0 percentage points[A] (IQI: -0.75 to 8.55) 11 studies (14 arms) 6 additional studies with mixed results	OR: 1.57 (95% CI: 1.35 to 1.82) 46 studies

*CVD studies from Bright review and from updated search

**Bright et al. 2012 examined CDSS for any risk factor or disorder

[A]Absolute percentage point change in proportion of providers completing CDSS-recommended practice

IQI = Interquartile Interval

Results were inconsistent for various CVD risk factor outcomes such as change in systolic and diastolic blood pressure, proportion of patients with their blood pressure controlled, change in total cholesterol and LDL-cholesterol, and proportion of patients with lipid parameters and A1C levels at goal.

While most studies (37 studies) assessed CDSS in isolation for CVD prevention, a small proportion (8 studies) employed CDSS as a tool within a multicomponent approach to overcome barriers at the patient, provider, organizational or community levels. These approaches ranged from systemic, organizational change such as team-based care - where primary care providers and patients worked together with other providers, mainly pharmacists and nurses, to improve the efficiency of healthcare delivery and self-management support for patients - to combining CDSS with one other component such as patient reminders. Larger improvements were seen in these multicomponent studies for CDSS-recommended screening and preventive care services ordered and for CDSS-recommended clinical testing but the increase in CDSS-recommended treatment prescribing was similar to the overall estimate.

Applicability and Generalizability Issues

Most of the CVD studies were conducted in U.S. settings. Almost all studies evaluated CDSS in outpatient, primary care settings, many of which were run by group practices that had multiple primary care centers. Many of the studies had relatively large study populations (median: 1189 patients).

Information on race and ethnicity was reported in one third of CVD prevention-focused studies. Data on socioeconomic status was sparse. In most study populations, patients had one diagnosed CVD risk factor--predominantly diabetes, high blood pressure, or high cholesterol. However, findings are likely applicable to diverse population groups and multiple CVD risk factors.

Data Quality Issues

Most studies were randomized controlled trials (RCTs). The remaining studies were quasi-RCTs or used other study designs with concurrent comparison groups. The most common limitations affecting this body of evidence were significant differences between intervention and comparison groups at baseline and incomplete descriptions of population demographics.

Other Benefits and Harms

Screening and evidence-based clinical protocols for diverse conditions could be consolidated within a single CDSS, e.g., CVD prevention, immunization, and cancer screening – which might improve comprehensive patient-care. No harms to patients from CDSS were identified in studies from the review or published in the broader literature.

Economic Evidence

The economic review included 17 studies (search period January 1976-October 2012). Most were conducted in the U.S., with a few based in Canada and Europe. Among the studies, 10 provided information about the cost of CDSS, 15 provided estimates for changes in healthcare cost, 4 provided cost-benefit estimates, and 3 cost-utility studies reported cost per quality-adjusted life year (QALY) saved. The included studies: (1) evaluated a range of CDSS functions; (2) focused on a diverse set of CVD risk factors; (3) used various types of metrics to report economic estimates; and (4) differed in completeness of the estimates in terms of inclusion of major components. Due to this heterogeneity the economic review does not provide median estimates and presents only a qualitative assessment of the evidence.

A majority of studies included in the economic review evaluated CDSS for management of a single CVD risk factor such as diabetes, high cholesterol, or high blood pressure and others incorporated management of multiple risk factors within the same CDSS. Intervention cost varied widely as studies evaluated CDSS for different functions (e.g., providing screening reminders, treatment recommendations, and patient assessments). Additionally, few studies provided the complete cost of developing, implementing, and operating the system. Different denominators (e.g., size of practice or size of patient sample) were used for various cost estimates, making it difficult to interpret available information.

While implementation of CDSS resulted in more instances of healthcare cost decreases than increases after CDSS implementation, the utility of this evidence is limited due to numerous reported estimates that did not include major components of healthcare cost.

Results from the included cost-benefit and cost-utility studies were inconsistent; partly due to the incomplete assessment of cost of implementing CDSS and its impact on healthcare cost. In addition, some studies implemented CDSS within systems-level organizational change such as team-based care, further complicating interpretation of economic outcomes. In summary, an overall determination about cost-benefit or cost-effectiveness cannot be reached based on available evidence.

Considerations for Implementation

In the rapidly evolving U.S. healthcare system, health systems need to plan for the move towards 'meaningful use' of EHRs and CDSS. The Centers for Medicare and Medicaid Services defines 'meaningful use' as a set of standards for EHRs

with the goal of improving the quality of healthcare. The Health Information Technology for Economic and Clinical Health (HITECH) Act—enacted in 2009 to promote the adoption and use of health information technology—incentivizes adoption of 'meaningful use' of EHRs and CDSS by health systems and individual practices and specifies deadlines for healthcare providers to demonstrate 'meaningful use' to avoid penalties affecting Medicare reimbursements.

Bright et al. (2012) identified nine contextual features associated with successful CDSS: (1) automatic provision of decision-support; (2) provision of decision-support at time and location of decision-making; (3) provision of a recommendation, not just an assessment; (4) integration with charting or order entry system to support workflow integration; (5) promotion of action rather than inaction; (6) precluding additional clinician data entry; (7) justification of decision-support via provision of research evidence; (8) local user involvement in development; and (9) provision of decision-support results to patients as well as providers.

Most CDSS for CVD prevention were locally developed by healthcare systems and providers. CDSS were added to pre-existing EHRs in about one third of included studies. In most studies, CDSS were designed to offer recommendations to providers without user requests for information, meaning the recommendations were 'system-initiated.' Also, a majority of CDSS were designed to deliver decision-support as part of clinical workflow (i.e., 'synchronously'). Few studies reported whether providers were required to respond to CDSS recommendations (e.g., by acknowledging receipt of a CDSS recommendation or registering a disagreement with a CDSS-recommendation).

The most important challenge to overcome for successful implementation is providers' inconsistent use of CDSS. Bright et al. found provider acceptance of CDSS to be low across studies. However, once accepted, provider satisfaction with CDSS was consistently high. It is important providers have an opportunity to give input during CDSS development and are offered regular training and orientation activities that help prevent 'alert fatigue,' wherein some providers ignore alerts.

The adoption of EHRs and CDSS represents a paradigm shift in patient-provider interaction. Decisions need to be made by health systems on ideal ways to gain provider acceptance, integrate systems with existing workflow, and better engage patients in the process. With advances in technology, it is likely that newer versions of CDSS have better capacity for integration into regular workflow and are more user-friendly than older versions.

CDSS is a tool that is likely more beneficial when combined with other drivers of efficient healthcare delivery. Health systems should consider implementing additional interventions that could be integrated with CDSS such as provider performance feedback reports or higher, system-level, organizational programs such as team-based care.

Evidence Gaps

Most CVD studies evaluated outcomes at a relatively short follow-up period of 12 months. Studies with longer term evaluations might be able to account for issues associated with the initial integration of CDSS with clinical workflow. In addition, studies need to collect data on the impact of CDSS on CVD risk factor outcomes and morbidity and mortality.

Most studies in this review developed CDSS for physicians. More studies are needed to assess the effectiveness of CDSS with other providers on the healthcare team such as nurses and pharmacists. Patient-centered outcomes and processes to involve patients in decision-making were rarely examined. More assessments of the impact of CDSS in reducing health disparities and improving patient satisfaction with care are needed.

More evidence from established CDSS in healthcare systems combined with information about implementation in real-world settings will increase understanding of the potential CDSS has to prevent CVD. Combining CDSS with other interventions to improve the efficiency of healthcare delivery is another focus area for future studies.

Finally, including public health recommendations within CDSS is a logical next step in the evolution of this tool.

More complete economic analyses are needed for CDSS that address CVD risk factors. Economic evaluations need to report the development or acquisition costs of CDSS as well as the operations and maintenance costs. It is also important for CDSS cost estimates to be based on standard denominators such as number of providers or size of practice. Similarly, information on healthcare costs needs to be complete in terms of impact on outpatient, inpatient, and other costs regardless of the functions of CDSS (e.g., treatment recommendations only vs. comprehensive disease management). More economic analyses are needed that model the impact of CDSS to distal economic outcomes such as cost per QALY saved and cost-benefit ratios.

The data presented here are preliminary and are subject to change as the systematic review goes through the scientific peer review process.

References

Bright TJ, Wong A, Dhurjati R, Bristow E, Bastian L, et al. Effect of clinical decision-support systems: a systematic review. *Ann Intern Med* 2012;157(1):29-43.

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