A Framework for Thinking about Clinical Decision Support

Having a framework for thinking about clinical decision support (CDS) centered around quality of patient-specific data, supported by some basic principles and a simple functional classification scheme, will facilitate decision making around CDS purchase, implementation, and measurement.

Why Do We Need a CDS Model?

Multiple frameworks have been developed that attempt to break CDS into categories along such dimensions as software capabilities, user-described functional domains, and mechanisms of intervention in clinical practice. There is no shortage of competing models to explain and categorize CDS; however, existing one-dimensional models are limited in their ability to describe and categorize the many types of CDS.

Health care IT leaders and staff think about CDS and all of its ramifications on an almost daily basis as they contemplate how to extract maximum benefit from their clinical information systems for patient care quality and operational efficiency. Common scenarios in which CDS functionality is considered include IT strategic planning; vendor selection, software implementation, and optimization; and quality and efficiency metric development and implementation planning.

We believe that organizations thinking about CDS can benefit for all of these purposes from a consolidated framework that combines features of previous models. We outline a two-part framework for describing CDS: 1) a construct for predicting the clinical value of different CDS types for effectively guiding clinicians to practice high-quality, high-efficiency care and 2) a functional categorization scheme for considering specific CDS mechanisms.

The Value Equation: Data Specificity vs. Effectiveness of CDS

Fundamental to determining CDS effectiveness is the degree of richness and patient-specificity of the data incorporated into CDS mechanisms. The best computational algorithms are only as good as the data upon which they operate.

The simplest CDS systems (CDSS) ensure accurate data entry and ordering in the absence of any patient-specific data. An example is order completion in CPOE systems: when ordering a treatment or test, the computerized process ensures that all of the components of the order will be completed (e.g., drug name spelled accurately and legibly, dose selected from available doses, route and frequency indicated). A correctly completed order is a baseline essential for clinical operation. A slightly higher level of sophistication occurs, for example, with checking of an ordered medication against other medications the patient is currently taking. Here the system is operating on patient-specific data (a current medication list).

As the richness and specificity of patient data incorporated into the CDS grows, so does the potential effectiveness of the CDS. Rules that evaluate drug dosing based on patient weight, age, and renal function can have a significant impact on dosing appropriateness and outcomes. Diagnostic test ordering that includes appropriate patient data as well as accurate indication for testing improves appropriateness of study selection and reduces unnecessary testing.

3 Adapted from Perreault et al., JHIMSS 1999;13(2):5-21.
Of course, complexity for its own sake is undesirable; the key to effectiveness is to incorporate only those patient-specific data that are directly relevant to assisting the clinical decision at hand.

**Figure: Patient-Specific Relevant Information vs. Potential CDS Value**

A very powerful type of decision support is “compound CDS”—applications where multiple CDS types work together to support a common patient care goal. Examples would be nesting diagnosis-specific ordering guidance and drug decision support within a broader order set, or a combination of physician ordering CDS that communicates with nursing documentation-triggered CDS in support of a multiday care pathway.

Many authors have promoted categorization systems for describing CDS-functional mechanisms. Given the evolving state of CDS applications and demands of the health care system on provider organizations, we suggest the following categorization scheme, adapted from Wright, Osheroff, and others.4,5 In contrast to these researchers, we have combined all medication-related CDS into medication management; modified the category titles to reflect CDS functions (what you do with the CDS); and added a category for patient-activation CDS to reflect the increasing need for, and availability of, CDS tools to influence patient behavior.

**Table: CDS Functional Categories**

<table>
<thead>
<tr>
<th>CDS Category</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Diagnostic CDS</td>
<td>Diagnostic aid software (e.g., Isabel)</td>
</tr>
<tr>
<td>Medication management</td>
<td>Drug-drug interactions, drug dosing, etc.</td>
</tr>
<tr>
<td>Order-based CDS</td>
<td>Order completion, order sets, protocols</td>
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</tbody>
</table>

Documentation-based CDS | E.g., guided documentation
Relevant information display | E.g., show laboratory results relevant to a medication order
Population-based CDS | E.g., disease registry, surveillance systems
Patient activation CDS | E.g., reminders to patients, relevant information pushed to patients

These categories are not mutually exclusive, and compound CDS may utilize several of these functional categories at once.

CDS designers must consider carefully the specifics of CDS insertion into clinical workflow. By considering both the value construct and potential delivery mechanisms, designers can make better decisions on what mechanism should deliver the CDS, to which providers or patients, and at what point during the episode of care. For example, relevant information display while ordering a chest x-ray order might include the date and time of the last chest x-ray; an order to start or adjust the dose of an aminoglycoside might be aided by display of a patient’s renal function.

In another example, a disease management registry that reminds caregivers that a patient seen today is due for an influenza shot will be a much more effective if the CDS is aware of the patient’s influenza immunization status; it is wasteful to administer the same vaccine twice. Some registries will be sufficiently interfaced to the EMR to incorporate such data into their CDS, but an Excel spreadsheet-based registry may not be.

In summary, considering both dimensions of CDS when designing interventions will increase the likelihood that a given intervention will not only satisfy, for example, meaningful use or other regulatory requirements, but also achieve the underlying clinical quality and efficiency objectives behind those requirements.

CDS Principles and Action Items

- Review your existing systems’ CDS elements with an eye to opportunities to obtain greater business value from them by considering the value and mechanism dimensions presented here. Consider both dimensions when designing or contemplating purchasing systems incorporating CDS.
- IT leaders should approach CDS implementation cognizant of a set of important principles that we have outlined previously. These include: attention to knowledge management and performance management; vigilance for unintended consequences; following best implementation practices; and use of appropriate governance.

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6 See “Guiding Clinicians Toward Accountable Care with Clinical Decision Support,” (June 2011).