INTEROPERABILITY CONCEPTS APPLICABLE TO CLINICAL DECISION SUPPORT

Definitions of interoperability within health care have matured over time. In 2013, the Healthcare Information and Management Systems Society (HIMSS) approved a definition of interoperability as the “ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged.” (1) The Office of the National Coordinator for Health IT (ONC), in following the IEEE definition of interoperability, added the notion that interoperable systems should allow exchange and use of electronic health information “without special effort on the part of the user.” (2) Even more recently, others have recognized that interoperability of electronic health information consists of four different types or “layers,” including 1) process, 2) semantic, 3) syntactic, and 4) technical interoperability. (3) This last concept, in which interoperability can only be achieved by addressing all four layers, is especially pertinent to clinical decision support (CDS).

Most regard CDS – and health information technology more generally – as having important social, clinical, and organizational components in addition to its technical aspects. (4) Consequently, implementers of CDS often describe CDS as a process and in terms of what it aims to do, rather than what it is (or is not). Often cited as the “Five Rights,” CDS aims to provide the right information, to the right audience, using the right channel and right format, at the right time during work flow. (5) There are many types of computer-based CDS channels and formats – alerts, reminders, dashboards, mobile apps, among others. To achieve the potential benefits of CDS, such as improved quality and safety, one has to deliver
each of the Five Rights within a process of quality improvement. To achieve interoperable CDS, one has to identify the process, semantic, syntactic, and technical layers so that the Five Rights framework can be transferable and replicable within the clinical domain of interest.

Breaking down the process of CDS development and implementation could help make CDS interoperability more achievable. The process is likely to be cyclical but often begins with an identified clinical need, such as a known gap in quality of care. (see Figure 1) To address the clinical need, health care systems transform clinical practice guidelines and other evidence-based sources of best practices into computer-based CDS that helps facilitate the best care possible. The CDS undergoes testing, implementation, and evaluation. Improvements to the CDS can occur at any point as lessons are learned and/or clinical needs change over time.

Figure 1. Cycle for clinical decision support development, implementation, and evaluation using CDS Connect tools and resources.

CDS CONNECT ADDRESSES KEY LAYERS OF CLINICAL DECISION SUPPORT INTEROPERABILITY

One way to help make the CDS lifecycle – and its technical components – more interoperable is to provide infrastructure for performing the initial translation of evidence-based care into CDS and for sharing components of the CDS process so that health care systems do not have to start from scratch. CDS Connect, prototype infrastructure for sharing and authoring CDS, was launched in 2016 by the Agency for Healthcare Research and Quality (AHRQ) in collaboration with the MITRE Corporation. CDS Connect (https://cds.ahrq.gov/cdsconnect) provides a publicly-available CDS authoring tool and national repository of CDS resources or “artifacts.”
CDS Connect aims to fill two related, but discrete, components of a CDS lifecycle. First, there is the logic component. Clinical practice guideline recommendations can be broken down into formal logic statements in the form of if/then rules. The if/then rules define the conditions under which the recommendations apply as well as the recommended actions (the who, what, when, where, and under what circumstances for each clinical recommendation). The if/then rules can also identify the data elements required to execute the logic. If even further developed, the logic can be expressed in a standards-based, computer-interpretable form. Recently CMS announced Health Level 7 (HL7) Clinical Quality Language (CQL) as the standard for describing the logic for e-measures required by CMS quality programs. (6) CQL harmonizes specifications for e-measures and CDS by helping both draw upon the same data elements. (7) CDS Connect makes available a CDS authoring tool that generates CQL and provides a repository for posting and sharing the CDS once authored.

Second, there is the knowledge an organization generates as it progresses through the CDS lifecycle. Most experts describe four levels or phases when translating clinical practice guideline recommendations from their native, prose-based form to the compiled, machine-executed form implemented as screens, tabs, alerts, or other interventions with which users actually interact. (8) (see Figure 2) Progressing through these levels requires finer and finer levels of granularity and less and less vagueness and ambiguity for the recommendations to be computable.

**Figure 2. Progression through knowledge levels when translating guidelines or evidence-based care into computable clinical decision support (CDS).**

- **Narrative**: Narrative text created by guideline or CQM developer
- **Semi-Structured**: Semi-structured text that describes the recommendations for implementation in CDS
- **Structured**: Structured code that is interpretable by a computer (includes data elements, value sets, logic)
- **Executable**: Executable code that is interpretable by a CDS system at a local level. This will vary for each particular site.
As they proceed through each level, organizations regularly face choices that depend on local constraints and priorities. For example, organizations must decide what data elements within their own system most closely correspond to those data required by the CQL. Choices exist about how to properly insert the CDS into workflow and what channels/formats are most appropriate for their clinicians and patients. Unlike the logic component, there is no standard that formalizes how organizations describe their journey through the four levels, the choices they faced, what choices they made, and why. Yet this aspect of the CDS lifecycle is critically important if the CDS is to be shared and reused. Other organizations need to be able to decide for themselves whether they face similar choices and need to make similar assumptions. As a platform for sharing CDS, CDS Connect enables discovery and use of this knowledge from one CDS implementation to another.

PILOT TESTING TO GATHER SHAREABLE LESSONS LEARNED ABOUT IMPLEMENTATION

For CDS developed within the CDS Connect project, knowledge about implementation came from pilot testing. In 2018, MITRE developed CDS to facilitate and inform pain management based on recommendations from the Centers for Disease Control and Prevention. (9) Through a summary, or “dashboard,” the CDS helped clinicians and patients evaluate together the patient’s pain experience over time, review treatments (including opioid medications, non-opioid medication and non-pharmacologic therapies), and assess risk factors to inform how the patient’s pain is managed moving forward. The CDS was piloted through collaboration with OCHIN, a Health Center-Controlled Network that serves community health centers across the country.

OCHIN implemented the CDS using a Substitutable Medical Apps, Reusable Technology (SMART) on Fast Healthcare Interoperability Resources (FHIR) application developed by MITRE (see Figure 3). (10)

The app served as the CDS engine that received the required data from the EHR, executed the CQL, and returned the results of the CDS back to the EHR as a pain management dashboard for review. In this case, OCHIN implemented the CDS as a screen that could be viewed simultaneously by both clinician and patient, thus facilitating shared decision-making. (11) Other organizations can learn from OCHIN’s experience, how the CQL was implemented, and what aspects of the implementation correspond to their own capacities and IT infrastructure via supplemental reports posted within the artifact on the CDS Connect Repository. (11, 12)
MEETING NATIONAL PRIORITIES FOR CDS INTEROPERABILITY

Sharing CDS through a national repository of CDS is one of the priorities for collaborative action recently identified by the National Academy of Medicine in its 2017 special publication, “Optimizing Strategies for Clinical Decision Support.” (13) The NAM recognized the importance of CDS interoperability given that CDS may be implemented across multiple platforms, electronic health records, and other technologies, both within and across organizations. In addition to a national repository of CDS, other NAM priorities are beginning to be addressed by AHRQ and its partners, including a patient-centered CDS learning community and a program for CDS research. (14) We have learned much over several decades of CDS research and implementation. With increasing support for CDS-related standards and the widespread adoption of EHRs, we look forward to inching closer and closer to interoperable CDS.
REFERENCES


14. For more information, visit https://cds.ahrq.gov.