CHAPTER

A Clinical Decision Support Implementation Guide: Practical Considerations

25

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25.1 Introduction

This chapter continues the theme introduced in Chapter 23, concerning organizational and cultural change considerations in preparing for implementation and continued support of clinical decision support (CDS), and Chapter 24, which discussed the business policies and procedures required to align CDS with organizational goals and processes. In this chapter we further examine both the foundational tasks and detailed processes that can be used to drive to successful implementation, by focusing on the steps involved in implementing a CDS package, defined as a collection of one or more CDS interventions directed toward particular objectives.

25.1.1 Source material for this chapter

Over the past decade, increasing numbers of stakeholders in improving care delivery and outcomes with CDS have come together to synthesize best practices for improving outcomes with CDS [www.himss.org/cdsguide]. The material in this chapter is drawn heavily from the latest publication in this guidebook series, i.e. Osheroff et al., *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*, 2nd ed., published by the Health Information Management Systems Society (HIMSS), and readers seeking further detail on this subject are encouraged to read this resource (Osheroff et al., 2012).

25.2 Foundational issues

First, a successful CDS program requires a strong foundation, including complete organizational support, involvement of key stakeholders and a shared understanding among them of key concepts, strong clinical and administrative leadership, and alignment of the program with organizational values and priorities.

Clinical Decision Support.

25.2.1 Definition of CDS and the "CDS five rights"

As we discussed in Section I of this book, CDS can carry different connotations – for example, conjuring images for some clinicians of unhelpful workflow interruptions from "pop-up alerts." In this chapter, we adopt a broad definition, shown below and extracted from the HIMSS 2012 CDS guidebook (Osheroff et al., 2012), which sets a collaborative and constructive foundation for an organization's CDS efforts:

> *Clinical decision support is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery. Information recipients can include patients, clinicians and others involved in patient care delivery; information delivered can include general clinical knowledge and guidance, intelligently processed patient data, or a mixture of both; and information delivery formats can be drawn from a rich palette of options that includes data and order entry facilitators, filtered data displays, reference information, alerts and others.*

This definition tees up the "CDS Five Rights framework," which is a valuable conceptual underpinning for considering the dimensions on which stakeholder efforts should be focused, to address high priority care delivery improvement targets. This framework asserts that, to apply CDS successfully to achieve such goals, the right information must be presented to the right people, in the right formats, through the right channels in the right points in workflow. The concept of the CDS Five Rights was first articulated in a guidebook on utilizing CDS to improve medication use, and builds on the Five Rights of Medication Management (Osheroff, 2009).

Approaching the CDS program-building activities outlined below with a shared stakeholder understanding of the broad CDS definition and the CDS Five Rights framework helps to ensure that these activities will achieve desired results.

25.2.2 Organizational support

Administrative and clinical leadership is essential for CDS program success. The leadership must show commitment to quality and patient safety programs and be able to connect them to the higher-level goals and priorities of the organization. In 2012, the Institute of Medicine report, "Best Care at Lower Cost," identified CDS as one of ten key recommendations for achieving the goals outlined (IOM, 2012). These goals certainly resonate with the current challenges and goals that most hospitals and clinics are facing. If the leadership is not committed to CDS-related initiatives, it will be difficult to obtain the necessary resources (analysts, physician champions, communication venues) and to overcome the expected resistance from staff and providers.

Clinical leadership, including the CDS physician champion, must be able to articulate how the CDS program fits in and facilitates attaining the goals and priorities of the institution. High-level goals may include reducing medication errors or

reducing readmissions, decreasing cost of care or length of stay, attaining specified quality goals (e.g. disease management, core measures, or pay-for-performance targets). It is the role of the clinical leadership to communicate how specific CDS interventions can help achieve these goals in a win-win fashion for all stakeholders, and why they are necessary.

As broad organizational goals are articulated and become more specific, they will need to be translated into goals appropriate for the various levels of the organization, such as management and staff and provider levels. This is important, because the true impact of the CDS intervention will occur at the staff and provider level at the point of care.

Clinical leadership should include medical staff leadership, nursing/pharmacy/ancillary leadership (for hospital environments), provider leadership (for group practices), other formal opinion leaders, and the physician champion. All of the clinical leadership should be on the same page regarding the goals of the CDS program and how it will be implemented (so this joint approach can be broadened ultimately to include all stakeholders, especially CDS recipients). Please see the discussion on the physician champion later in this section.

25.2.3 IT support

IT support is just as critical as the leadership support described above. Appropriate resources and personnel should be assigned to the CDS program to ensure that technical intervention development and related projects are completed in a timely manner and with appropriate quality control. The CDS program must be seen as an important facet of the clinical systems that is well-implemented and well-supported by the IT department (or EHR vendor for smaller practices).

25.2.4 Measurement

Measurement of the impact of CDS interventions is important for several reasons. Depending on the goal of the intervention, documenting improvement in a quality metric, length of stay, or cost/expense will provide support for the program. Providers will want to know how the intervention improves quality or efficiency, and that any potential "extra clicks" are worth it. Administrative leadership will need to see documented results in order to continue to fund the CDS program.

Measurement should begin prior to the implementation of the CDS intervention to provide baseline data. Data capture can be difficult, especially in a paper-driven clinical environment, and current processes may need to be modified to allow for it. In the United States (US) the HITECH Act and Meaningful Use (see Chapter 2) are driving the adoption of electronic health records (EHRs) in both hospital and office settings. The result will be that some aspects of the data capture process will require design of electronic templates (i.e. requiring structured data elements instead of free text or dictated entry).

As with choosing an intervention, choice of measurement should reflect the important values and priorities of the organization. The opportunity to utilize the CDS program to have impact on organizational priorities can provide significant support to further program development and requests for additional resources.

25.2.5 The CDS committee

Most hospitals and large physician groups will have a formal CDS committee that functions to shape and manage the CDS program.

Often, the CDS committee in a hospital is an official medical staff committee, and reports to the medical executive committee or the hospital board. It is important to assure credibility of the committee through a formal reporting structure, especially when there is resistance to a specific CDS intervention or the program in general. Even in group practices, the "CDS Program" – which will typically be integrated with other basic business functions – will need to define clear roles for practice providers and staff.

Typically, the hospital CDS committee is chaired by the physician champion or the CMIO. A clinician who is clinically active and can translate the organizational goals into concrete interventions will serve well in this position. Membership of the committee should be multidisciplinary and include all levels of providers (nursing, residents, and advanced practice clinicians such as nurse practitioners and physician assistants). Providers from various departments, both primary care and specialty, should be represented. Although the more "tech-savvy" clinicians may volunteer, it is also important to include those that are less facile with the systems as well as the unofficial opinion leaders of the medical staff. If these stakeholders can gain an understanding of how the organizational goals are addressed via CDS interventions, and can understand the impact and value, they have the potential to become strong allies and ambassadors of the CDS program. Representation from the pharmacy is critical, since pharmacists are intimately involved in the medication administration process. Ancillary departments such as respiratory therapy, nutrition, and infection control should be included on a continual or as-needed basis.

Other important departments to consider include quality and patient safety, risk management, case management and appropriate IT representation. It is usually beneficial to include the IT manager of CDS and the analysts involved in developing the CDS interventions.

The committee should meet frequently enough to maintain continuity of tasks and ensure continued participation by members. The goals of the committee should be to develop the strategy, assist with prioritization of requests, guide the execution of interventions, and monitor the progress and results of implemented interventions. The committee should be familiar with process improvement tools such as the iterative process improvement cycle tool, "Plan-Do-Check-Act" (PDCA) (see http://en.wikipedia.org/wiki/PDCA); cycles; and rapid-improvement events (see http://www.institute.nhs.uk/quality_and_value/rie/rapid_improvement_events_an_overview.html). There are many resources available to acquaint committee members with process improvement tools.

HIMSS has a number of Web pages devoted to this area (see http://staging.himss.org/himssstage/asp/topics_managementProcess.asp).

A charter for the CDS committee can be helpful to frame the goals and responsibilities of the committee and its members. If the committee is an official medical staff committee, then a charter will be essential. The charter should include a description of goals, duties or responsibilities of members, member composition and governance, meeting schedule, decision-making process, and reporting structures.

25.2.6 The physician champion

As noted, the physician champion (PC) is a key player in the success of any CDS program. The individual that serves as the PC should be a respected member of the provider community, and should be an active user of the systems that will be impacted by any intervention.

The most important skill for the PC is communication. This is critical both for leading the CDS committee and for communicating with the clinician community in general.

The PC should be actively engaged throughout the CDS intervention lifecycle. This individual will serve as the main conduit of information between the IT department developing the intervention and the end users who will be impacted. It is imperative that the PC is able to translate the needs of the end users and the impact of any intervention to the IT staff. Conversely, he/she will need to communicate the capabilities and limitations of the clinical systems to the end users and the CDS committee.

Most organizations find that, for the PC to be effective, he/she must have dedicated time – separate from clinical practice responsibilities – to spend with the IT staff and in the clinical environment, championing the CDS program and obtaining feedback from the clinical users.

Clinician end-user champions also play a key role in the development and implementation of a CDS intervention. They can assist the PC with evangelizing the CDS program and in translating the proposed value of the specific interventions. They also serve as liaisons between the IT staff and the general clinician user community.

25.2.7 Engaging stakeholders and communication

Engaging stakeholders is a critical success factor. Involvement of key personnel does not begin at the implementation phase of the CDS intervention, but instead should begin at the launch phase of the CDS program. It is important that the end users have the perception that all the organization's CDS interventions are happening with their support and input, and are not being thrust upon them without warning. Involving stakeholders throughout the process – from defining the improvement opportunity, through implementing the solution, to measuring and enhancing its effects – will build a shared appreciation for the clinical and operational challenges associated with a CDS program. End users must never feel like

unwilling targets of the CDS intervention, and that changes to the system are occurring without their knowledge or warning.

"End users" and "stakeholders" are broad terms and should include all those impacted by the interventions, both upstream and downstream. This includes all types of providers (physicians, residents, advanced practice clinicians), nursing staff, pharmacy staff, and other ancillaries that are directly or indirectly involved in patient care. Upstream targets are those directly interacting with the intervention, such as providers using the clinical information system, pharmacists verifying medications, and nurses during medication administration. Downstream targets include everyone who is subsequently impacted by the CDS intervention. An example would be a radiologist receiving a specific request that was ordered through a guided order set. Involvement and feedback from the IT staff that are participating in building and testing the intervention can be very revealing and should be considered during all steps

As noted earlier, it is important that the communication and engagement plans include both official leaders and the unofficial opinion leaders from the clinical population. Clinical staff that both support the CDS program and especially those that publicly or privately resist should also be included. Their concerns can be an important source of information about potential issues that could interfere with implementation and ultimate success of the CDS efforts. Often, their concerns may reflect genuine issues and should be considered. This is sometimes difficult, given that the comments may be buried within a more generalized expression of discontent. Utilizing the resistors on the CDS Committee or during the testing phase can potentially alter their perception and change them into supporters or evangelists for the program. Marginalizing resistors should be undertaken with caution, and should only be attempted when acceptance of the overall CDS program by the vast majority (including the official opinion leaders) has been achieved.

Communication can facilitate the understanding and acceptance of the CDS program and specific interventions. Transparency of the process, as described above, is one aspect of a successful communication process.

Communication regarding the CDS program and specific interventions should follow the principle that it is desirable to "communicate many times, in many different ways." The CDS program should be communicated through discussions at group and department-level meetings. Connecting the CDS program to specific interventions and to organizational goals and priorities will build a shared understanding of the purpose and acceptance of the possible impact on the end users.

Communication of specific interventions should be done through multiple venues, including e-mail, strategically placed flyers and posters, short articles or blurbs in the publications targeted toward providers (e.g. medical staff newsletters), and personal communication from the physician champion and members of the CDS committee to their constituencies. It is often helpful to target individuals or groups who may be specifically impacted by the intervention. Ideally, several of these people will have been previously involved in the planning and design of the implementation.

The development of the message should address the issue of "what's in it for me" ("WIFM"). Providers will support programs that contribute to organizational

goals, but will also look for personal "value-added" benefits. These benefits could include improved efficiency, increased access to data, more efficient order entry, more complete documentation that supports improved coding, or a reduction in call backs for clarification of orders.

Another effective means of communication is the cross-fertilization of members of the CDS committee with other related committees. Having providers as members on several committees can dramatically improve communication and feedback regarding proposed and implemented interventions. This cross-fertilization also provides members with a broader perspective and a greater understanding of organizational priorities. Example committees include: pharmacy and therapeutics, quality improvement, medical records, health care information management, and other performance improvement committees.

25.2.8 Assessing the readiness for change

A critical theme for ensuring success and reducing resistance is to manage expectations and maximize communication with the end-user community. The implementation of a CDS intervention cannot be the first time that the users are exposed. The launch of the intervention should serve as one of the key mileposts along the path of the CDS program's target-focused efforts. As previously noted, the work done to engage these stakeholders and overcome resistors should have laid the groundwork for acceptance. The members of the CDS committee should act as evangelists during the implementation, communicating the value statements and quality improvements achieved by the intervention.

Assessing the change environment is an important phase of the process of managing expectations. Through communication with the CDS Committee and other identified stake holders, the potential for acceptance versus resistance should be somewhat predictable. If needed, a formal readiness assessment should be undertaken. This would include direct communication with individuals representing the various classes of end users to assess their understanding of the CDS program and the specific interventions being planned. The assessment should also include identifying end-user expectations regarding response time, total number of clicks, and impact on work flow.

25.2.9 System issues: Hardware and infrastructure

A CDS program cannot succeed if the infrastructure cannot support it. The underlying network, whether in a hospital or a community-based practice, must be able to support the added demand on bandwidth that CDS packages place on the system. The devices used by the clinicians (workstations, laptops, mobile devices) must also be compatible and be able to support the applications and specific changes brought on by the CDS packages.

The assessment of the infrastructure should occur early in the process, to identify potential problems and allow time for remediation. A common impediment to

acceptance of CPOE and CDS programs by clinicians is the nonavailability of sufficient devices with which to enter orders, create and review documents, and interact with the CDS interventions. This may result in clinicians avoiding the systems and instead using verbal/telephone orders, which will bypass any CDS intervention and could impact patient safety.

A catalog of the infrastructure and networks, along with capabilities, load capacity, and reliability, is helpful in understanding the impact that the CDS program will have. This catalog should also include an inventory of end-user devices and peripherals (printers, etc.).

Some factors to consider in the catalog include[1]:

- The number of workstations and other devices as measured per bed/exam room/clinician.
- Status of the workstations: age/speed of processor, amount of memory, operating system.
- Overall reliability of the system: downtime statistics, reliability and pervasiveness of the wireless network (if utilized), speed of the network, and load capacity (if multiple users are logged on at the same time or are accessing the same wireless access point).
- Need for telemedicine support: remote monitoring capabilities.
- Speed and reliability of remote access: for clinicians that access the system from home or office.
- Impact of other medical devices (monitors, pumps, etc.) on the speed and reliability of the network (wired or wireless).
- Ability for foreign devices with nonstandard operating systems to access the systems (especially true with the growing use of mobile phones and tablets for such purposes).

25.2.10 Software

To fully leverage the capabilities of the CDS program, it is important to understand the systems and applications of those systems available to provide decision support to the clinicians. Just as it is important to have a catalog of the hardware, devices and network, a catalog of the clinical and nonclinical information systems can contribute to the planning and implementation of specific CDS interventions.

The catalog of clinical information systems could include:

- A listing of all clinical information systems and applications available in the enterprise.
- The current version of each system and the current available version from the vendor. This step can identify gaps in versions that may impact functionality and effectiveness of CDS interventions.

[1] Adapted from Figure 3-1; *Improving Outcomes with Clinical Decision Support: An Implementer's Guide, 2nd ed.*, published by HIMSS (see reference i); used with permission.

- A listing of supporting systems required for the main clinical information systems. Examples include required operating system versions, required browsers and versions, required supporting software (e.g. JAVA). Again, required versions should also be noted.
- The catalog should also include applications that may be used for reference by the clinicians or that may be used to provide data for specific CDS interventions. These are applications that the clinicians do not use to enter data, but with which they may interact to find information. Examples of these applications include drug reference data bases, background clinical calculators, or evidence-based content libraries.
- Clinical applications may each use a specific vocabulary of terms (e.g. SNOMED, LOINC, ICD-9/ICD-10). It is important to know which vocabulary is used to ensure the CDS intervention is tailored appropriately. Specific vocabularies may also require standardization across applications for exchange of data and more sophisticated CDS interventions.

25.3 Implementation issues

Once the foundational issues have been addressed via a CDS program, it is time to determine specific CDS targets. As noted earlier, it is often helpful to utilize the CDS Five Rights to provide a framework and guide the process of selecting, planning, implementing and supporting a CDS intervention package. It is important to remember that an intervention package will typically include multiple specific interventions, focusing on a single or several targets where key decisions or actions occur.

There are many resources available on the Web that provide useful information regarding implementing CDS packages. These include those provided by the US ONC (Office of National Coordinator for Health Information Technology) (2013); the CDS Collaborative for Performance Improvement (ONC, 2013) and the HIMSS website for CDS (HIMSS, 2013).

25.3.1 Identifying specific CDS objectives

In the process of evaluating potential CDS interventions for a specific goal, it is often helpful to build a framework to assess the desirability of a CDS objective. Figure 25.1 exemplifies such a framework. Factors such as potential impact or organizational benefit must be weighed against factors such as cost of development of the intervention, impact on system performance, and impact on clinician work flow and satisfaction. Potential patient impact includes factors such as number of patients affected, severity of the patient care/quality issue being addressed, and impact on patient satisfaction. Organizational impact includes factors such as regulatory or compliance requirements, enterprise-wide quality and safety improvements, and potential liability impact. Development costs must consider resource requirements both inside and outside of the IT department (development and testing

Clinical Objective Value Score* = (P+O+C+N+G) – (D+C)

P = Patient impact (individual/population) (positive, for example, higher quality, safe, cost-effective care; improved morbidity and mortality; improved patient satisfaction)

O = Organizational impact (positive, for example, regulatory or audit compliance (such as alignment with Meaningful Use requirements), appropriate resource use, support for internal improvement priorities, reduced liability, financial return)

C = Clinician impact (for example, enhance workflow/compensation, support for consensus practice patterns and operations, improving care capabilities, projects of particular interest to clinicians)

N = Number of patients positively affected

G = Gap between ideal and actual behavior and outcomes pertinent to the objective

D = Difficulty associated with addressing the objective (for example, related to intervention configuration, adoption and use)

C = Cost of addressing the objective (such as from procuring and maintaining intervention content and technology)

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* Consider the strength of systematic evidence about the magnitude of the variable when practical.

FIGURE 25.1

Factors affecting the desirability of a CDS objective. *Taken from the HIMSS 2012 CDS guide (Osheroff et al 2012, Figure 5-2, page 156) reproduced with permission.*

analysts, clinicians used for testing, etc.). As noted earlier, the impact that CDS interventions have on overall system performance must always be considered, especially as the number of interventions increases. In a similar manner, the impact of the CDS interventions on clinician workflow and efficiency must also be considered along with clinician satisfaction. The balance between clinical quality improvements and the potential for "alert fatigue" should be part of the consideration; alerts that interrupt workflow should typically be used as a "safety net" that fire only after other approaches to supporting appropriate decisions haven't produced the desired action.

It is important to articulate and quantify when possible the impact the CDS intervention will have on quality improvement, patient safety, operational efficiency, or financial performance. Although the CDS intervention may not directly have an impact on revenue, there may be a reduction in unnecessary or duplicative testing, reduction in length of stay, improvement in quality metrics (e.g. core measures, Meaningful Use criteria, or pay-for-performance programs), or improvements in clinician efficiency and satisfaction. Connecting specific interventions to higher-level organizational goals will build support for the CDS program and can assist

in procuring additional resources (both internal to the IT Department (staffing and expertise, etc.) and external (provider and ancillary participation)).

25.3.2 The CDS Five Rights

Many clinicians are familiar with the "Five Rights of Medication Administration." It is a framework to better understand the requirements for accurate and safe administration of medications. In the world of clinical decision support, "The CDS Five Rights" has been developed to provide a framework when developing and implementing a CDS package. The CDS Five Rights model states that CDS-driven improvements in selected targets are achievable if we communicate:

- The ***right information***: Evidence-based, suitable to guide action, pertinent to this circumstance.
- To the ***right people***: Considering all care team members, including clinicians, patients and their caretakers.
- In the ***right CDS intervention formats***: Such as an alert, order set, documentation tool, or reference information.
- Through the ***right channels***: Such as through an EHR or personal health record or mobile device messaging system.
- At the ***right times in the work flow***: When it is most needed to make a decision or take action.

These CDS Five Rights address the what, who, how, where and when for CDS interventions. As a CDS intervention package is planned, these guidelines can ensure that the goal is accomplished most effectively and efficiently.

25.3.3 The CDS package

There are many clinical scenarios in which a single CDS intervention would not be sufficient to address the issue or opportunity. In these cases, several interventions (such as an order set with an embedded documentation tool to capture contraindications for a quality measure-related order) packaged together would represent the most effective solution. During the planning process and the discussion of the CDS Five Rights, consideration of all potential intervention points (instead of just one), pertinent information, and intervention delivery recipients/formats/channels will prove to be the most effective approach and result in a solution with the greatest impact.

25.3.4 CDS intervention types

When planning a CDS intervention or package, it is important to have the full catalog of intervention types available to choose from. An understanding of the options can help prevent jumping to the most well-known solutions (e.g. alerts, orders sets), which might not be the best choice, or even an appropriate one at all (in the case of interruptive alerts).

There are many ways to categorize the various CDS intervention types[2]. One catalog bases the framework at the task level. Using this perspective, we can consider the CDS intervention to occur during data entry, data review, or during the assessment and understanding of the clinical situation, or it may be triggered by data received at a specific time or due to an external event (such as lab test result availability).

Interventions that occur during data entry may involve:

- Documentation forms (checklists, etc.)
- Orders sets
- Care plans/protocols
- Real-time guidance (display of clinical data relevant to the order being placed, suggested drug dosing adjustments based on clinical situation, or forms with built-in calculations)
- Real-time alerts (such as regarding drug interaction, drug allergy, maximum dose)

Interventions that occur during data review may be integrated with:

- Single patient clinical summary forms (such as preventive care flow sheets with highlighted required tests, immunization summaries with highlighted required immunizations, or core measure flow sheets with highlighted incomplete measures)
- Multiple patient summary forms (such as unit-based displays showing patient status or status of tests or procedures in progress, lists of patients coming into an office that day, or those needing to be called based on due date for a screening procedure such as a mammogram)
- Analytic tools that display either retrospective or predictive trending (such as unit-based control charts, syndromic surveillance tools, or dashboards that highlight potential acute changes in patient status based on pre-programmed algorithms)

Interventions that occur during the assessment and understanding of the clinical situation include:

- Access to reference information (e.g. Web-based resources, evidence-based resources, context-sensitive resources that are triggered based on specific information being viewed in the clinical system such as Infobuttons, or links to clinical calculators)
- Interactive resources (such as differential diagnosis generators, antibiotic advisors, or management algorithms)

Interventions triggered by data or time include:

- Event-triggered alerts (e.g. alerts triggered when new results are received in the system, alerts about lack of follow-up by the clinician or patient within a specified period of time, or alerts that required interventions have not been done within a specified time frame)

[2]List adapted from Osheroff et al. (2012): Figure 5-5, Page 165.

25.3.5 CDS and computerized provider order entry (CPOE) implementation are not the same thing

Although intimately related, the CDS program and CPOE are separate efforts and need to be clearly differentiated from each other. The implementation of CPOE frequently overlaps with CDS efforts; and in many organizations the CDS program begins only after CPOE has been implemented. Also, of course, CPOE provides multiple opportunities for useful integration of CDS. But, as noted above, CDS includes far more then CPOE-based functionality – that is, CPOE is just one ***channel*** for CDS intervention delivery. When possible, the CDS program and CDS Committee should be created before CPOE is planned and implemented. This will provide the opportunity to develop and implement those CDS intervention types previously described that do not require CPOE. The benefit of this approach is that the difference (both philosophically and operationally) between CDS and CPOE will be clear in the minds of leadership and the end user community. Consequently, any barriers or resistance to CPOE can be clearly separated from the planning and implementation of the CDS program. An important tool in promoting this understanding is the CDS Five Rights framework. This framework can illustrate how a CDS program and specific CDS packages reach far beyond CPOE.

25.3.6 Selecting CDS interventions

In selecting a CDS intervention and designing the overall CDS package, it is important to consider organizational goals and values. The goals of the CDS program and the specific interventions should support the clinical, operational and financial goals of the organization. As previously noted, aligning CDS interventions with organizational goals will often result in the greatest amount of support and resources.

This principle is illustrated by efforts to address the common and important organizational goal of reducing 30 day readmissions for particular conditions. In the US, with the development of value-based purchasing and numerous pay-for-performance and other quality programs, readmissions carry significant negative financial consequences for hospitals and for newly forming Accountable Care Organizations (see Chapter 2). A targeted CDS intervention package to identify patients at risk for readmission – and reduce this risk – could be valuable to an organization. The package may include a discharge checklist, a tool that calculates readmission risk, and patient education/engagement material to help patients understand their condition and treatment and prepare them to self-manage most effectively.

25.3.7 Connecting CDS interventions to organizational priorities

The organizational impact should be articulated during the development of the goal, with specific measurable outcomes clearly defined. These can include reduction in medication errors, reduction in duplicate testing, and reduction in length of stay or overall cost of care. Improvements in efficiency of the clinicians or operational departments should also be identified. During times of constrained resources,

the goal of improving quality of care may not be sufficient to obtain the required resources to develop and implement the intervention. When possible, the cost of development/implementation of each CDS intervention should be quantified. This will facilitate the cost-benefit analysis required to support the intervention.

Not all organizational priorities can be supported by CDS interventions. Clinical decision support is best targeted at processes that can be improved through the provision of clinical information at the point of care or decision making. The various types of CDS interventions described earlier in this chapter help illustrate this point.

25.3.8 Using a worksheet to determine CDS interventions

Once a target is chosen that aligns with organizational priorities, and the CDS Five Rights framework is broadly understood by key stakeholders, the next task is to determine the specific CDS intervention(s) that will be implemented. It is often helpful to first think about the entire continuum of care process that is being targeted. Mapping out the process will help the CDS team and other people involved in thinking broadly about the problem. Too often, people will begin the process with a specific intervention in mind, without considering the entire care process and other potential areas for intervention. The most common example usually involves requests for alerts or orders sets to address a specific problem. When evaluating the entire care process, interventions targeted earlier in the process (e.g. during initial documentation or patient evaluation) may be more effective.

A tool that may be helpful in mapping out the care process is a process flow diagram. Worksheets, such as the one shown in Figure 25.2, have been used by many organizations to assist in applying the CDS Five Rights, to determine effective configurations for a target-focused CDS intervention package. These types of worksheets have been in use, and are under continual refinement by the CDS Collaborative for Performance Improvement (Collaborative, 2013). This collaborative is a multi-stakeholder effort wherein healthcare related organizations are working together to apply CDS more effectively in addressing performance improvement imperatives. Such worksheets have also been significantly refined under an ONC contract to develop tools for CDS-enabled quality improvement (ONC, 2013).

25.3.9 Workflow

Understanding the care process as previously described is an important step in the CDS planning process. Understanding the workflows of all of the stakeholders that are impacted by the intervention represents another critical step. Although CDS interventions may not always improve workflow, a neutral impact that still achieves the desired goal should be the minimum accepted outcome. The most effective CDS interventions will add value to the workflow by improving clinical quality and the delivery of knowledge and information at the point of care, or other points in the care delivery process without adversely affecting time required, or perhaps even improving it. For example, an order set is a form of decision support that, if

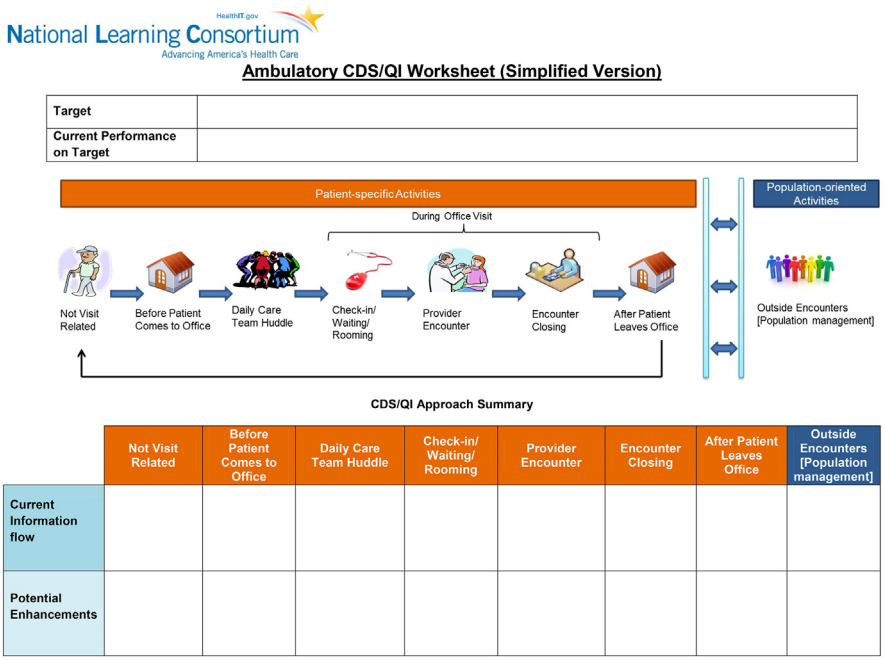

FIGURE 25.2

Excerpt from simplified CDS/QI Worksheet for ambulatory care target.

appropriate to a situation, can both improve care and improve efficiency by automating the selection of anticipated orders.

Workflows in a clinical process include all of the steps performed at the various points in time by all of the people who are involved. This includes patients and all potential ancillary departments impacted by the care process.

Workflow mapping is an important skill for successful CDS efforts, since, once the current processes – and opportunities for improvement – are understood, it is more likely that the modifications developed will be helpful and successfully implemented. People familiar and facile with workflow mapping should be added to the CDS team when possible. This may be a full-time requirement, or individuals with these skills may be pulled into the process when needed. In more resource-constrained environments, some individual with the interest and capability to observe and document workflow nuances and opportunities should be identified. The more experience the CDS team has with workflow mapping, the more efficient the process will become. Standard workflow mapping tools are available and should be utilized when possible. These will promote familiarity with the process and allow all members of the team to contribute. It is important to remember that the personnel working on the workflow map are typically clinicians, who may not be familiar with these types of tools. Therefore, it is important to keep the

tools as simple as possible, so as to more easily engage the clinicians and other stakeholders. Tools that are too complex will distract attention from the task at hand and result in reduced efficiency. It is often helpful to start with simple workflows or ones that have already been mapped to familiarize the team with the process and tools.

The workflow map should identify the various steps in the care process pertinent to the improvement target: who is performing each step, how each step will be accomplished, and opportunities to increase efficiency/effectiveness, and who is the target. The information and data that are being made available or being transferred at each step should also be identified. Review of the overall process may then identify opportunities where a CDS intervention could be designed and implemented.

25.3.10 Selecting an intervention package

Use of tools such as CDS configuration worksheets and workflow maps should facilitate the identification of potential opportunities for CDS interventions. Often, common patterns emerge in the care processes that lend themselves to specific CDS interventions. Many of the CDS intervention types previously described can be employed during the initiation of care (e.g. admission to hospital or ambulatory/ED clinic visit). An example could include an order set that helps to determine and document venous thromboembolism (VTE) risk and then suggests specific prophylactic measures. Also, checklists and data entry forms based on admitting diagnosis are often utilized during this step of the care process. After the clinical data have been collected and entered, CDS interventions are commonly employed during the assessment/plan steps. Examples may include: dosing guidelines integrated into order sets for specific medications or for specific medical conditions, context-based links, associated with conditions in problem lists or drugs on medication lists, to evidence-based or other Web-based references, and diagnosis-based or procedure-based order sets.

As care is provided and more information is collected in the system, ongoing opportunities for decision support occur. This may include guidance for further diagnostic testing or therapies, based on existing results or documented problems, alerts regarding critical results of laboratory tests, and care plans or procedure guidelines that are activated as the hospital course unfolds. Time-based reminders and event-driven alerts are also commonly employed during this phase of care. CDS interventions that enhance communication are also important during this phase of care, and especially during transitions of care (e.g. the discharge process). Examples include smart documentation forms that are automatically communicated to the receiving facility or provider during transitions of care. Patient discharge instructions that auto-populate with patient education information based on discharge diagnoses or procedures can be very valuable to the patient and represent a value-added time saver for the clinicians.

It is important to remember that a single CDS intervention may not accomplish the desired goal. An intervention package, consisting of several different CDS

intervention types, may be required to achieve the desired effect. This perspective may help overcome common barriers to CDS acceptance and use, including clinicians bypassing standard order sets and data entry forms and instead utilizing free form entry (if available), or clinicians not utilizing the Web-based or evidence-based links embedded in the system.

25.3.11 Configuring the intervention

There are several key components to most interventions. These include: the trigger, logic, data source, notification type, and presentation. These components need to be considered during the design and workflow evaluation for any CDS intervention. Not every component will be part of every intervention.

Interventions require triggers when they are only expected to appear at specific times or events. Ongoing patient monitoring does not require a specific trigger. CPOE represents a classic trigger mechanism. When a trigger is activated, logic is required to determine whether the condition exists for the intervention. Notification of the intervention (i.e. presentation of clinically relevant information or recommendation) must occur at the right point in the care delivery sequence. This may be in real time, or in some asynchronous fashion. The presentation of the alert should be targeted to appropriate user at the appropriate time and in the appropriate system. Several studies have been conducted to identify key features of CDS packages that are associated with success. Examples include: providing both assessments (such as pertinent associated lab values) and recommendations (such as adjustment of medication doses) together, and providing real-time decision support integrated in the workflow (Kawamoto et al., 2005; Bright et al., 2012).

25.3.12 Factors to consider when building the intervention

There are many factors that should be considered when building the actual intervention. Computer-user interface design considerations are critical at this stage, and can significantly impact user acceptance and satisfaction. It is important to understand the capabilities and limitations of the application that will host the intervention. Applications may only be able to present alerts in certain modes, and may have limitations on screen design. It is important that the CDS Committee and those involved in the design of the intervention understand the limitations of the applications, and that expectations regarding the capabilities of potential interventions be clearly communicated.

Most interventions will facilitate workflow and enhance efficiency by presenting information at the most appropriate point in the workflow. Some interventions, such as alerts, may involve either a "soft" or "hard" stop. Soft stop interventions are presented to the user but do not require a response before proceeding. Most alerts are constructed as soft stop alerts, so as to not potentially impede the care process. A hard stop intervention will not allow the end user to proceed without addressing what is on the screen. This may include a dialog box or pop-up that must be

acknowledged before proceeding, an order set or data entry form that requires that a selection be made before processing, or an alert (such as a drug allergy warning) that requires entering a reason for overriding the alert. Hard stop interventions should be reserved for critical processes or critical patient safety issues.

Other user interface issues that should be considered in the design of the intervention include the use of a consistent and simple user interface. Buttons that accept or process an action should have a consistent location on the screen or alert display. As users become more facile, they began to expect buttons, tabs and other navigation tools to be consistent from screen to screen. The use of scrolling should be limited, so as to present the maximal amount of information on-screen. Vertical scrolling is usually more accepted then horizontal scrolling, especially for lists of orders or reference information. Screen response time and overall speed of the system and user interface are critical factors for acceptance. Limiting the number of mouse clicks and screens that must be navigated are important considerations.

25.3.13 Approval process for interventions

The approval process for implementing an intervention should follow a formal, predefined workflow. Approval of the content is usually an iterative process involving the clinical "owner" of the intervention, the technical analyst building the intervention, and the physician CDS champion or CDS Committee. Depending on the potential impact of the intervention, further approvals may be required. This may include the department or division chair, nursing administration, and often the medical executive committee of the institution.

A standard and broad-based approval process provides several advantages and disadvantages. Exposing the proposed intervention to a wider audience will facilitate acceptance and enhance communication of the CDS process in general. The primary disadvantage is the inherent time lag associated with obtaining approval from multiple people or committees. For most interventions, this is an acceptable cost; however, for critical patient safety issues, a more streamlined approval process may be required.

25.3.14 Intervention go-live

Implementing a CDS intervention is the easy part; user acceptance and value delivery represent the true challenge.

An assessment of the end users' comfort level with the clinical applications represents an initial step in evaluating success. Clinicians that have difficulty navigating the clinical information system screens may be overwhelmed with the introduction of a CDS intervention. The availability of additional training and education for the applications may be required before introduction of any CDS intervention.

As previously discussed, involvement of key stakeholders, official and unofficial opinion leaders, and organizational support are important factors for success at

this stage. It is critical that stakeholders have been included throughout the process to avoid them reacting as if the CDS intervention was being imposed upon them without their knowledge. Clinical decision support is most successful when it is perceived as a team sport by the entire organization and done ***with*** stakeholders instead of ***to*** them.

When possible, it is helpful to begin by implementing "soft" interventions that are perceived as useful or time-saving by the clinicians. Examples include order sets that facilitate order entry and include evidence-based content. Making these order sets available to end users is often an effective way to introduce CDS. Once the users acclimate to the initial interventions, more invasive interventions can be considered and implemented. Moving the users along this "continuum of intrusion," starting with small wins, is an effective change management technique. If the initial interventions include "hard stops" and other mandatory responses, clinicians will be more likely to resist and voice their dissatisfaction with the clinical information systems in general. If and when hard stops are introduced, this should be done in such a manner as to promote recognition by the recipients that these “guardrails” are helpful and not intrusive.

Communication, as previously noted, may be the most critical success factor. The stakeholders and all targets of the CDS intervention must be made aware prior to implementation. Communication should include the reasons for the intervention, the quality or patient safety issue being addressed, and the impact on them as end users. The CDS Committee should participate in the communication process. Members can help communicate the overall value of CDS, the specific value of the intervention, and can act as evangelists and provide support once the intervention is live.

Optimal communication occurs in multiple venues and in multiple forms. Important interventions or those further along the "continuum of intrusion" cannot be over-communicated. Discussion of the CDS program and specific interventions can occur at various meetings and in the hallways among colleagues. The use of print materials, such as posters or "cheat sheets" should be considered. E-mail can be an effective tool, depending on the overall usage of the e-mail system. The goal should be to launch interventions that are anticipated and welcomed by recipients, and seen as valuable tools for efficient, effective care delivery.

25.4 Conclusions

A successful CDS program that improves care and impacts outcomes clearly requires more than implementing an EHR system and “turning on the CDS capabilities.” Building the road is very complex and takes tremendous effort. Models, such as outlined here and in the HIMSS CDS Guidebook (Osheroff, 2012), are emerging, and understanding best practices, costs, benefits and challenges are works in progress (Nebeker et al., 2005; Wadhwa et al., 2008; Romano & Stafford, 2011).

The foundation for a successful CDS journey requires commitment of all key stakeholders, a persistent effort of the leadership and CDS Committee, and continual focus on the priorities of the organization.

Once these key pieces are in place, the journey can begin. The road includes both technological innovation and cultural change. As with all continuous improvement initiatives, a CDS program is a never-ending effort. As goals are achieved, CDS packages will require revision. There will always be new organizational priorities and initiatives; and previously implemented CDS packages require periodic review and revision. Maturation of evidence-based care will also drive continual revision and improvement to CDS package content. New tools will be added to the CDS toolbox as EHR functionality improves; implementing these new tools will require continuous learning by everyone involved in clinical decision support.

The road to CDS success is ongoing and ever-changing. Having the fundamental pieces in place and the vision to focus on organizational priorities are essential to navigating this critical aspect of the care process.

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