Infusing Clinical Decision Support Interventions into Electronic Health Records

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Electronic medical records and health records provide a variety of clinical decision support interventions to guide or support the clinical user. These interventions are designed to guide users in next steps, offer useful evidence-based knowledge, or provide patient information relevant to a decision.

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Key Words: Clinical decision support (CDS), clinical decision support interventions, clinical decision support applications, electronic health record (EHR).

Objectives
1. Define clinical decision support.
2. List several types of clinical decision support interventions.
3. Discuss applications for clinical decision support interventions in nursing.

(Osheroff, Pifer, Teich, Sittig, & Jenders, 2004, p. 3). This support provides the nurse with the appropriate clinical evidence resources associated with accurate patient assessments and test results. These data are quickly available, providing the ability to make the right decision at the right time within the right place and to the right person. If information and resources are not available, the nurse may be unable to make a decision and implement care interventions in a timely manner. All clinical disciplines that have access to the electronic health record will enter and/or use information. These data are integrated within an electronic health record. Thus, health care decisions are multidisciplinary and include the patient’s perspective.

Types of Clinical Decision Support

Several types of clinical decision support (CDS) interventions are available within electronic health records (EHRs) and electronic medical records (EMRs) that provide support for those delivering care (Kawamoto, Houlihan, Balas, & Lobach, 2005; Osheroff et al., 2007). These CDS interventions may or may not be used with the EMR of a health care facility (such as a hospital or clinic), but are often available across health care delivery areas.
within a larger health system’s EHR. When the EMR or EHR is purchased, CDS interventions are not routinely provided unless requested and subsequently designed with some level of customized specifications for the health system or local facility. The EHR and EMR repository of data is used within many CDS interventions. These data are secured by passwords, and access is traceable, thus providing a level of security and confidentiality to the health care information with any clinical decision support intervention.

Electronic Form
The first type of CDS intervention is an electronic form and is common in many health care settings. The electronic form can be designed to guide patient data entry (see Figure 1). The instructing guidance provides support when completing interviews and observations at admission, during daily care, when performing focused assessments, and implementing interventions. The user is able to access the full scope of assessments and patient care activities available within the EMR/EHR electronic form. The user is given tips for when a section of the form should be completed and how to complete it. Typically, the EMR/EHR uses point and click responses, and thus, requires minimal typing skills. Instructions and tips within electronic forms are most helpful for the novice, new orienting staff, and nursing students. Physicians and other disciplines may use the same sections of electronic forms, and thus, data entry is shared. This CDS intervention supports documentation of care by using reusable templates that are available to all appropriate health care providers wherever they work. The reusable templates are sections within electronic forms that allow data to be integrated from all settings. The section on urologic assessments would be an example of a reusable template.

Figure 1. Example of Electronic Forms with Instructional Statements

![Image of a completed skin test form with instructions on how to fill it out.](source.png)

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Figure 2. Example of Order Set with Order Details for Clinical Condition

![Image of an order set with clinical details and order options.](source2.png)

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Provider Order Sets
Another type of CDS intervention is the provider order sets (see Figure 2). The order sets contain order sentences to first guide the provider selecting the order details during computerized provider order entry, and next guide the nurses and therapists who need to interpret and perform the intervention. An example is the set of standardized care interventions and patient care orders for a urologic procedure designed for the physician or nurse practitioner to efficiently place orders. The provider selects the pre-designed urologic order set that has the common order sentences pre-selected and optional selections for additional orders. All pre-selected and optional orders are organized under common categories, such as medications orders, continuous intravenous orders, and therapy orders.
This CDS intervention facilitates standard specifications for order sentences, including required and optional order details for individual orders. Required details ensure a more complete order that meets the needs of evidence-based practices. A standardized order set provides complete order details for medication orders, diagnostic tests, diet, activity order, and therapies following evidence. After the provider enters orders with an order set, nurses, pharmacists, therapists, or dietitians immediately see the complete order details as part of the patient’s plan of care. These can be used to ensure that care is uniformly delivered and eliminates phone calls to clarify or discuss what was omitted. For example, the order sets specific to urologic procedures would provide details on start time, end time, dose, reason or condition for performing the procedures as intermittent catheterization, or continuous catheterization, which removes the ambiguity often associated with written and incomplete details with an order.

When the order sets are developed for physicians, nurses and all clinical departments responsible for executing that order correctly need to be involved within the design and development of order sets. Therefore, nurses within the urologic specialty will need to review all developed physician urologic order sets for the EMR/EHR before approved for use. Nurses should ensure that each order is clear, understandable, and complete, with all order details present in the order sentences to guide those in training and new staff.

Prescriptive Plan of Care

A third type of CDS intervention is a prescriptive plan of care to identify priority problems and patient preferences. The plan of care or care set is pre-designed so the nurse can quickly select and modify as necessary (see Figure 3). The pre-designed plan of care is based on best evidence and standards. The nurse identifies the plan appropriate for the patient respective of his or her desired preferences and outcomes. This pre-packaged plan provides the ability to quickly identify pre-selected care orders, add optional care orders, or unselect interventions. As a result, this CDS intervention provides guidance by linking nursing diagnoses, patient outcomes, and nursing interventions and assessments to evaluate the expected outcomes. This CDS intervention functions similar to the physician’s order set and aligns the care within the patient’s EMR/EHR record. This clinical decision support reflects the established linkage between nursing diagnosis, outcome expected, and nursing intervention (American Nurses Association [ANA], 2005). Branching pathways are designed with evidence-based linkages to guide choices for nursing interventions that have been documented to have an effect to change the condition/nursing diagnosis.

Drug Databases

The fourth type of CDS intervention provides all clinical disciplines with drug databases that intersect with the EHR. It monitors patient medication(s) for drug-allergy interactions, drug-drug interactions, drug-food interactions, and therapeutic duplications (see Figure 4). This CDS tool provides instant access to drug information for all clinicians and for patient education. Most EMRs and EHRs will use a database to generate alerts. The accuracy of the nurse’s early admission assessments and documentation of allergies, home medications, and height and weight are helpful data to support the interaction checking and dose range checking for all disciplines. In many situations, the nurse’s documentation is needed to allow the CDS intervention to function for all health care providers.

Bar Coding

The fifth type of CDS inter-
Figure 4.
Example of Drug Database Alert for Drug-Allergy Interactions

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Figure 5.
Information Button to Provide Definition or Reference Text

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intervention is primarily used by nurses to administer medications. This involves a bar code medication scanning device that ensures the right patient, drug, dose, route and time occur. Medications are often delivered once a day to the nursing unit in unit dose, bulk dose, or unit stock. Using the device requires that the nurse check the bar code on the medication to the patient’s arm band. The device then determines if this is the right medication and dose for the patient’s profile. If data do not match, a short message is displayed, allowing the nurse to recheck the information and avoid an error in administration. The device often links with the drug database, giving instant access to drug information.

Evidence Button

The sixth type of CDS intervention provides information, reference text or a definition for the clinical condition, normal range, intervention, or procedure (see Figure 5). The information buttons are designed to link nursing or medical definitions, descriptions, or related details to provide clinicians with references at the bedside (Bates et al., 2003; Osheroff, 2009). This CDS provides information from nursing research manuscripts and professional nursing organizations about anticipated drug therapeutic effects and side effects. Electronic forms, orders, and alert messages may have an associated information button to click for evidence and articles.

If – Then Logic Module

The last type of CDS intervention is the most complex in design and requires broad representation of experts to develop. CDS is provided through an “if – then” logic module. This requires the use of critically appraised evidence and experts to design the use of data within the work steps of the user. When and if the conditions exist, a synchronous or asynchronous step occurs within the EHR or
EMR. When a synchronous action occurs, the user will receive a message detailing what actions are possibilities (see Figure 6). When an asynchronous action occurs, the user will not immediately receive a message or notice, but will receive orders, actions, communications, or a potential problem added to the list. This logic module, when triggered, assesses conditions before providing a message that details options and actions or recommends an assessment or intervention. Advanced nurse practitioners often help by identifying the evidence to guide the development of the logic for the clinical decision support rule. Clinical programmers will insert data requirements for the CDS rules per the oversight of expert clinicians. Nurse experts will often work with clinical programmers to ensure that responses from the CDS are appropriate and reflect the particular needs of the institution, and are evident for this patient population. The specifications needed for the CDS if – then logic model are achieved through the collaborative effort of expert clinicians and the EMR/EHR staff.

Other CDS Interventions

Other types of CDS assimilate patient information using a user-friendly display screen, provide trend views with charts, and display coloration of data outside the normal parameters, critical high and low laboratory values, or noticeable deviation from set parameters. The assimilated patient information appears as a patient summary view or dashboard providing a historical summary necessary to make decisions. The summary is compiled by running reports on the found data and presenting a dashboard of the summary findings, such as intake and output, mean and range for glucose readings, heart rate, and blood pressure, as well as the 24-hour dose levels for medications, current medications, and interventions.

Applications for Use in Nursing

CDS interventions may or may not be included in EHR/EMR systems. These tools can support a nurse throughout the nursing process. Several examples have been employed within EMRs and EHRs to support the practice of nursing and could be considered.

Assessments

The documentation or data collection of patient assessments are supported by the development of the electronic flow sheet and/or electronic forms. For example, urinary functional assessments (Fung, 2006) have been designed into an electronic form to guide collection of concepts for elimination (such as frequency, urgency, and sensation) and characteristics (such as odors, colors, and volume). The input of expert nurses is necessary to test the EHR/EMR electronic form or flow sheet designs. This ensures nurses will be able to use assessments using a standard set of data elements and observable indicators, thus allowing appropriate and accurate judgment of a
Direct links to measuring a patient’s progress and decline over time will require further development and the input of nurses to improve the design of existing EMRs and EHRs.

Patient’s Progression or Decline

Diagnosing Problems and Identifying Preferences

After these data are collected, CDS interventions are used to organize assessments and other clinical findings to display the trends and summarize the patient’s history. A CDS intervention organizes the patient’s information and provides instructions that can be used to guide the next steps, which may include identifying priority problems, selecting nursing diagnoses, or developing a problem list. This not only will ensure problems are identified but will provide patient-centered care. Several types of CDS interventions are available to help nurses diagnose problems and identify patient-desired outcomes. EMR/EHR applications include CDS logical rules, summary displays, and usability guides with evidence-based references, coloration, or trend charts. Health care institutions include the documentation of the patient’s expectations, values, and beliefs, as well as the family’s assets (Agency for Healthcare Research and Quality [AHRQ], 2006). Patient-centered information is often part of the discharge planning process and instructions in preparation for discharge from a hospital, homecare services, or ambulatory visit.

Planning Care

Once priority problems have been identified, two types of CDS interventions are available: 1) order sets and 2) plan of care sets. Either intervention provides pre-selected and optional nursing interventions, as well as specific details related to care for patient problems and urologic diagnoses. Each order set and care plan is pre-coordinated (ready for use), with evidence-based reference knowledge to support the interventions (Bates et al., 2003; Kaushal et al., 2006). Urologic physicians may also use pre-coordinated order sets to quickly select orders and edit details for a patient’s specific conditions and co-morbidity. Nurses will use pre-coordinated care sets (care plans) with pre-selected interventions supported by evidence-based guidelines and optional interventions to individualize for patients with co-morbid conditions. Pre-selected orders, when used, should be supported by a higher appraised level of evidence, such as meta-analysis and prospective clinical trials, or systematic reviews from research studies (Bobb, Payne, & Gross, 2007). When evidence supports the use of care interventions for specific problems, care interventions are designed to be required or pre-selected, while other interventions may be optional choices for the nurse to individualize the patient’s care.

Performing Interventions

In using the EMR/EHR, each health care provider can quickly review and manage the integrated plan of care with other disciplines. Multidisciplinary patient-centered care is possible with shared electronic plans of care and electronic forms. Some EMR/EHRs link documentation to orders to facilitate follow-through with care. Several CDS interventions include the use of “info buttons” and reference texts, which link to definitions, descriptions, and evidence-based procedure details. Info buttons are a resource for the new staff member and others performing infrequent interventions. Guides on steps for the procedure or actions to take are reminders. Students often benefit from having the reference guides.

Evaluating Outcomes

For most, the nursing process needs to be supported by CDS interventions that require a clinician’s response to the patient status on a regular interval. CDS interventions that include branching pathways linking the indicated outcomes to measure as relevant to the problem/diagnosis and the interventions are not as available in current EMRs/EHRs. These outcome assessments provide indicators for measuring the status for the patient’s desired outcome. Direct links to measuring a patient’s progress and decline over time will require further development and the input of nurses to improve the design of existing EMRs and EHRs.

Implications

CDS interventions are being developed and put into operation within hospitals, clinics, and community settings, and are not yet perfect systems to support continuous nursing care processes across shifts and settings. Nurses will need to provide feedback when defects, issues, or delays hindering care are experienced. These challenges may include the inability to document patient assessments or interventions, the inability to compile the necessary informa-
Table 1.
Types of Requests for CDS Interventions

<table>
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<th>CDS Interventions</th>
<th>Examples</th>
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| Prevent Errors                         | • Bar code medication administration applications with alert messages about wrong drug, route, and dose when giving medication to patients  
  • Alert messages for duplicate therapy and interactions (drug-allergy, drug-drug, drug-food interactions) |
| Promote Safety                         | • Displaying documented precautions and risks (falls, pressure ulcers, deep vein thrombosis, urinary tract infections, bleeding)  
  • Alerts for laboratory results (creatinine levels) before contrast medium  
  • Adverse drug event alerts for laboratory values or vital sign measures |
| Communication and Data Exchange        | • Electronic plan of care with organized standardized prescribed orders  
  • Controlled list of safe abbreviations and standardized language for medical, nursing, therapy, health and drug concepts  
  • Automatic notifications of clinical disciplines based on the patient's clinical findings |
| Embed Evidence-Based Practices         | • Documentation templates for urology assessment, intake and output self-calculating display, discharge template  
  • Reference guidance through URL links, information buttons with the intervention activities  
  • Renal dosing guidance  
  • Order sets and care sets based on best research findings |

In one view for decision making, the inability to find information or evidence if located in an obscure location, and the occurrence of too many alerts that interrupt care. When the EHR or EMR results in the inability to make patient care decisions, nurses should not accept the current workflow, but rather, report the issue (or gap) through the institution’s tracking process to report problems in using the technology. Nurses can improve the EMR and EHR systems by reporting defects, errors, and issues to the informatics nurses or health IT analysts who support the systems 24/7. These logs of defects and issues lead to improvement of technical and information gaps in current EMRs and EHRs.

CDS interventions will provide the right information (evidence-based interventions and valid assessment tools) to make health care decisions if nursing specialists assist in the CDS development. The CDS intervention may include a wide variety of solutions to support the nurse with the use of messages, orders, warnings, reminders, alerts, screen display instructions, and real-time reports that compile findings into a dashboard. The nurse or other health care providers will have more access to knowledge-based resources through personal digital assistant devices or through secure Internet or intranet-accessible guidelines that connect with the EMR/EHR. Foremost, the CDS intervention must be observed (not ignored) and used within a routine daily workflow of care activities on the unit or clinic (Garret al., 2005). The CDS intervention will need to be presented in the right location and to the right person when a decision or action is required. CDS interventions are in their infancy, and therefore, will need continuous evaluation and improvements as nurses use data in EMRs/EHRs. Overall, CDS interventions are considered a benefit if they support the efficiency and quality of the decision with more valued information (Kaushal et al., 2006). The ultimate goal would be for complication prevention or improved patient outcomes within a reasonable period of time.

It is important to know that CDS interventions are available to assist the nurse in making health care decisions when using volumes of data. The purpose for a CDS intervention request may be to prevent errors, promote safety, communicate information, or provide evidence-based practices. Examples of interventions used to support a purpose are presented in Table 1. Health care providers specializing in urology will need to request the clinical decision support intervention and provide the evidence to support the request. Requests should state the rationale, such as to support dosing of medications when there is renal decline, to remove urinary catheters when no longer indicated to reduce risk of infections, or to communicate to the consulting physician, enterostomal therapist, or social worker when findings require their services.

**Conclusion**

In conclusion, nurses have been known to adapt rapidly to changes with the EHR. A variety of types of interventions may be used to support clinical decisions. Nurses should consider tracking displays, electronic documentation templates and/or flow sheets, care sets, protocol branching pathways, alert mes-
sages, and information links using buttons on the screen as tools to support decisions. Unfortunately, not all tools are fully applied within current systems due to the resources required to design, maintain, and monitor their effectiveness. Further research is necessary to prove the effectiveness of tools before re-application of CDS interventions is realized on a broad scale in the health care industry.

New tools for the health care delivery system exist but are not fully realized. Many organizations do not understand the benefits of the various CDS applications needed to be a part of EHR implementation and long-term development.

References


Additional Reading