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Optimizing Clinical Pharmacy Services by Enhancing Clinical Decision Support

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Learning Objectives

- Determine best practice for CDS governance.
- Examine how CDS can support the transition of care.
- Assess how CDS can be used to support population health initiatives.
- Evaluate the patient complexity tool and integration into CDS.
- Design a plan to integrate CDS into daily work and dashboards.

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CDS: The Basics

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What is Clinical Decision Support (CDS)?

- Clinical decision support (CDS) is defined as a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery.

http://healthit.gov/providers-professionals/clinical-decision-support-cds

Ten Commandments for Effective Clinical Decision Support

1. Speed is everything—this is what information system users value most.
2. Anticipate needs and deliver in real time—deliver information when needed.
3. Fit into the user's work flow—integrate suggestions with clinical practice.
4. Little things can make a big difference—improve usability to "do the right thing."
5. Recognize that physicians will strongly resist stopping—offer alternatives rather than insist on stopping an action.
6. Changing direction is easier than stopping—changing defaults for dose, route, or frequency of a medication can change behavior.
7. Simple interventions work best—simplify guidelines by reducing to a single computer screen.
8. Ask for additional information only when you really need it—the more data elements requested, the less likely a guideline will be implemented.
9. Monitor impact, get feedback, and respond—if certain reminders are not followed, readjust or eliminate the reminder.
10. Manage and maintain your knowledge-based systems—both use of information and currency of information should be carefully monitored.

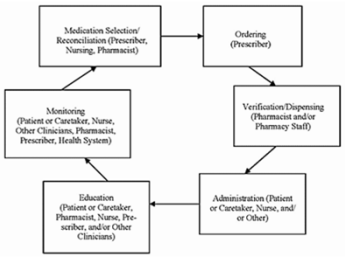
Bates DW, et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc.* 2003 Nov-Dec;10(6):523-30.

CDS Five Rights

- Interventions may contain a trigger, logic, notification, data presentation, and/or action Items
  1. What (Information)
  2. Who (Recipient)
  3. How (Intervention Type)
  4. Where (Information Delivery Channel)
  5. When (in Workflow)

Osheroff JA, et al. (2012). Chapter 1: Basic Concepts and Approach. In (HIMSS) (Ed.), Improving Outcomes with Clinical Decision Support: An Implementer's Guide, Second Edition (pp. 15). Chicago, IL.

Medication Management Cycle



http://healthit.ahrq.gov/ahrq-funded-projects/clinical-decision-support-initiative/chapter-1-approaching-clinical-decision/section-3-applying-cds-medication-management

Asynchronous Alert Examples

Alert Type/ Nomenclature	Explanation of the reasoning for firing of this alert
Potassium Toxicity Alert	• Warn of potential toxicity when ordering a drug which may exacerbate an existing high serum potassium level
Anticoagulation Alert	• To provide a warning of potential coagulation compromise when ordering heparin on a patient with recent PTT values that would predispose the patient to developing an adverse drug event. • Alert evokes when heparin order is added to the scratchpad. Recent PTT values are then checked for prolonged bleeding times which may be indicative of over coagulation.
No Creatinine Alert	• The medication lists are pulled from the Creatinine Clearance asynchronous rules. • This rule will present an alert when the provider is entering an order for a nephrotoxic or renally excreted medication and the patient does not have a recent Creatinine Serum lab result within a specified number of days.
No PT/PTT/INR Alert	• This rule will present an alert when the provider is entering an order for an anticoagulation medication and the patient does not have a recent PT/PTT or INR lab result within a specified number of days. • The medication lists are pulled from the Anticoagulation asynchronous rules.
Pregnancy/ Lactation Alert	• This rule will present an onscreen alert when a medication that has been identified as a risk is ordered and the patient is pregnant or lactating.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243248/pdf/1207_amia_2011_proc.pdf

Meaningful Use of the Electronic Health Record (EHR)

- Eligible Hospital and CAH Meaningful Use Table of Contents Core and Menu Set Objectives - Stage 1(2013 Definition)
  - Implement drug-drug and drug-allergy interaction checks. (Available)
  - Implement one clinical decision support rule related to a high priority hospital condition along with the ability to track compliance with that rule. (Available)

http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Meaningful_Use.html

Meaningful Use of the Electronic Health Record (EHR)

- **Stage 2 Eligible Hospital and Critical Access Hospital (CAH) Meaningful Use Core and Menu Objectives Table of Contents (**October, 2012)
  - Use clinical decision support to improve performance on high-priority health conditions.

Measure

1. Implement **five** clinical decision support interventions related to four or more clinical quality measures at a relevant point in patient care for the entire EHR reporting period. Absent four clinical quality measures related to an eligible hospital or CAH's patient population, the clinical decision support interventions must be related to high-priority health conditions. It is suggested that one of the five clinical decision support interventions be related to improving healthcare efficiency.
2. The eligible hospital or CAH has enabled the functionality for drug-drug and drug-allergy interaction checks for the entire EHR reporting period.

http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Stage_2.html

Inpatient CPOE + Clinical Decision Support Systems (CDSS)

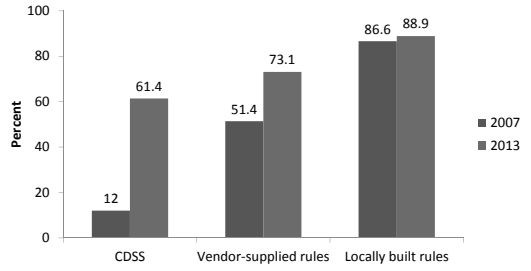
- Clinical decision support systems (CDSS) include any tool within the CPOE application that provides guidance and/or incorporates knowledge to assist the prescriber in entering complete, accurate, and appropriate patient care orders.

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-655. http://www.ajhp.org/content/72/8/636.full.pdf

Inpatient CPOE + CDSS

- Does your institution use extensive clinical decision support systems (e.g., rules that integrate order information, patient information, and clinical practice guidelines into computer system logic that provide feedback to prescribers) within the inpatient CPOE system?
  - Yes/No
- Rule sources
- Use of data (e.g., lab) from EHR
- Use of patient-specific data

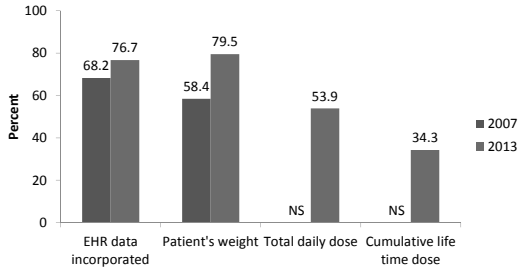
Inpatient CPOE + CDSS: Overall*



*Of hospitals that have CPOE

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

Inpatient CPOE + CDSS: Use of Clinical Data*



*Of hospitals that have CPOE; NS = not surveyed

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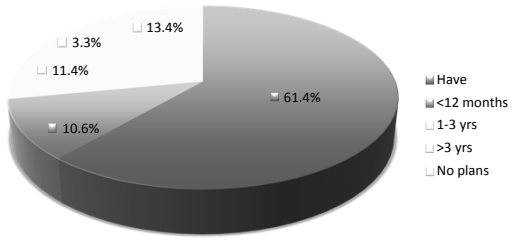
Inpatient CPOE + CDSS: Plans



ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

Inpatient CPOE + CDSS: Takeaways 1*

- ~50% increase CPOE + CDSS overall
  - Specialty hospitals least likely
  - Likelihood similar across other types and sizes
- Substantial increase in use of vendor-supplied rules
  - Use is consistent across types and sizes
- Little change in custom rules, but use is wide spread

*Of hospitals that have CPOE

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

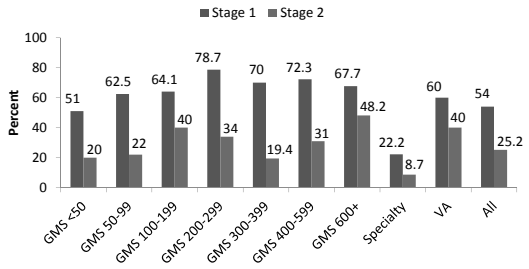
Inpatient CPOE + CDSS: Takeaways 2*

- Use of clinical data
  - Weight-based dosing is common
  - Total daily dose determination more common than not
  - Life-time dosing determined in 1/3 of hospitals

*Of hospitals that have CPOE

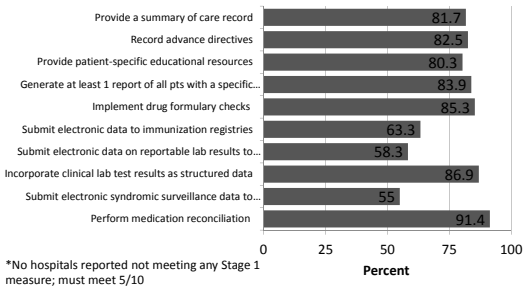
ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

Meaningful Use: Core Measures



ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

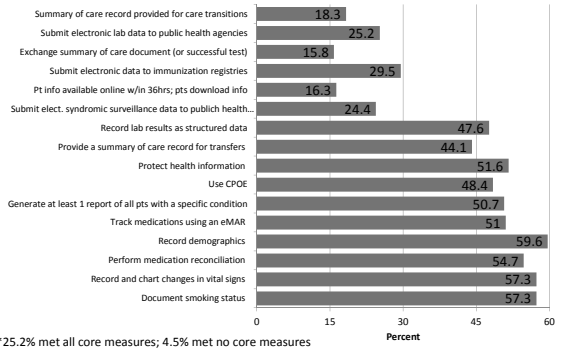
Meaningful Use: Stage 1 Menu Measures*



*No hospitals reported not meeting any Stage 1 measure; must meet 5/10

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

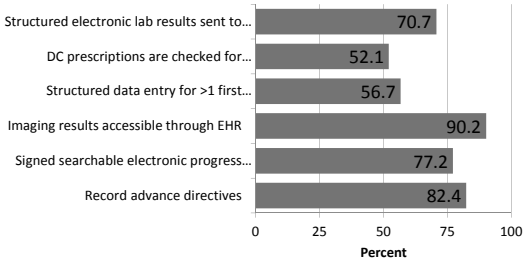
Meaningful Use: Stage 2 Core Measures*



*25.2% met all core measures; 4.5% met no core measures

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

Meaningful Use: Stage 2 Menu Measures*



*Must meet 3/6 measures

Meaningful Use: Takeaways

- ❖ Hospitals meeting all core measures
  - Stage 1: 54%
  - Stage 2: 25.2%
- ❖ No hospitals reported not meeting any Stage 1 measure
- ❖ Among those not meeting all Stage 1 measures:
  - Maintaining an active allergy list (35.1%)
  - Exchanging clinical info among providers electronically (22.4%)

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Meaningful Use: Takeaways

- ❖ ≥50% hospitals meet all Stage 1 & 2 menu objectives
- ❖ 2 of top 3 Stage 1 menu items focused on medications: med rec & drug formulary checks
- ❖ HIE important infrastructure for MU interoperability
  - 40.5% currently submit to HIE
  - 13.3% do not
  - 46.2% do not know
- ❖ Challenges with submission to external agencies

ASHP national survey on informatics: Assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2013. *Am J Health Syst Pharm* 2015;72:636-55. http://www.ajhp.org/content/72/8/636.full.pdf

Taxonomy of CDS Intervention Types

- ❖ CDS during data-entry tasks
- ❖ CDS during data-review tasks
- ❖ CDS during assessment and understanding tasks
- ❖ CDS not triggered by a user task

Osheroff JA, et al. (2012). Chapter 5: Foundational Considerations for Effective CDS Interventions. In (HIMSS) (Ed.), Improving Outcomes with Clinical Decision Support: An Implementer's Guide, Second Edition (pp. 167). Chicago, IL.

CDS During Data-entry Tasks

- Smart Documentation Forms
  - Checklists, clinical documentation forms, patient self-assessment forms, health-risk appraisals, etc.
- Order Sets, Care Plans, and Protocols
  - Admission order sets, conditional order sets, protocol and multi-phased pathways, treatment algorithms, etc.
- Parameter Guidance
  - Suggested drug, guided dose algorithm, forms to support complex orders, templates for documentation, TPN, etc.
- Critiques and Warnings – "Immediate Alerts"
  - DDI, drug-allergy, therapeutic duplication, DRC, critique, other warnings

CDS during data-review tasks

- Relevant data summaries (single patient)
  - Health maintenance flow sheet, Immunization status, quality metrics (MU), rounding lists, status boards, etc.
- Multi-patient parameters
  - Tracking systems (ED or OR), Status boards
- Predictive and retrospective analytics
  - Syndromic surveillance, predictive tools (sepsis, pressure ulcers), quality improvement comparisons

CDS during assessment and understanding tasks

- Filtered reference information and knowledge resources
  - Infobuttons (medication list to drug monographs with dosing and/or side effects)
  - Links from dose calculators within a CPOE system
- Expert workup and management advisors
  - Diagnosis decision support, antibiotic advisors, etc.

CDS not triggered by a user task

- Event-driven alerts (data-triggered) and reminders (time-triggered)
  - EHR text message pager alerts (abnormal labs)
  - Reminders about due for therapies (Vaccines)
  - Meds or Therapies reminders for renewal of orders
  - Standardized letters to patients about lab results or procedural reports
  - Monitors for ADEs

Reducing False-Positive Alerts

1. Collect and analyze site-specific alert data that are downloaded from the CPOE or pharmacy systems to identify and evaluate frequent alerts.
2. Evaluate all protocols and medication order sets for alert potential as part of the approval process. Require the HIS vendor to have the option to turn off alerts that are a part of order sets.
3. Do not wait for CPOE to address potential alert fatigue; address it with the current pharmacy system.
4. The addition of alerts should be carefully considered in relation to existing alerts and their value. Is the alert specific enough or will it have a low value and contribute to alert fatigue? How often will it fire? Can it be tested first?
5. Require the vendor database to enable customization of alerts to the individual user or subspecialty. This enables the user to turn on or off specific interactions depending on practice and knowledge base.

Cash JJ. Alert fatigue. *Am J Health Syst Pharm*. 2009;66(23):2098-101.

Reducing False-Positive Alerts (cont.)

6. Require the vendor database to allow suppression of an alert for a specific user once it has been overridden. This helps address repeat alerts and the tendency for most of the alerts to fire for only a few of the patients.
7. Update allergy profiles so previously tolerated medications do not alert in the future and use coded reactions rather than free text.
8. Consider including a suggestion on how to resolve the alert such as alternative medication that would not have the same allergy or interaction.
9. Analyze potential and actual medication error reports for missed alerts and consider coding that information into the ADE database.
10. Do not only turn on the moderate and severe drug interactions by blindly accepting drug interaction severity classifications, as they can still have a high number of less-significant interactions.

Cash JJ. Alert fatigue. *Am J Health Syst Pharm*. 2009;66(23):2098-101.

Identifying True-Positive Alerts

1. If a student, technician, or other staff member enters an order, the alert should repeat for the physician or pharmacist. Certain high-risk alerts may not be bypassed by a student or technician.
2. Review all bypassed alerts daily (or priority alerts if the daily list is too long).
3. Consider adding a reason or justification for certain high-risk alerts.
4. Analyze potential and actual medication error reports for errors where an alert may have been helpful and consider coding that information into the ADE database.

Cash JJ. Alert fatigue. *Am J Health Syst Pharm*. 2009;66(23):2098-101.

Identifying True-Positive Alerts (cont.)

5. Pharmacists and physicians are at risk for alert fatigue, so turning off alerts only for physicians does not solve the problem.
6. Do not blindly accept drug interaction severity classifications.
7. Require the vendor database to enable customization of alerts to the individual user or subspecialty.
8. Do not only turn on the severe drug interactions by blindly accepting drug interaction severity classifications.

Cash JJ. Alert fatigue. *Am J Health Syst Pharm*. 2009;66(23):2098-101.

Clinical decision support for drug–drug interactions: Improvement needed

- Survey completed in 2009 on DDIs identified the following areas for improvement:
  - Alert fatigue
  - Severity classification accuracy
  - Severity classification consistency
  - CDS content
  - Limited software customization
  - Quality of DDI evidence base
  - User interface customization
  - Provider knowledge of DDIs
  - Standardized management of alerts.
  - Providing management options
- Continued development of DDI CDS software combined with patient-specific management will reduce the risk of DDI induced patient harm associated with DDIs.

Horn JR et al. Clinical decision support for drug–drug interactions: Improvement needed. *Am J Health-Syst Pharm*. 2013; 70:905-9

Other Strategies

- Comparison of new orders to historical orders for 5 drugs:
  - Calcium
  - Clopidogrel
  - Heparin
  - Magnesium
  - Potassium
- Atypical orders decreased during the 92 days the alerts were active when compared to the same period in the previous year (from 0.81% to 0.53%; p=0.015).
- 50/68 atypical order alerts were over-ridden (74%).
- Over-ride rate is misleading because 28 of the atypical medication orders (41%) were changed.
- Atypical order alerts were relatively few, identified problems with frequencies as well as doses, and had a higher specificity than dose check alerts.

Woods AD, et al. *J Am Med Inform Assoc.* 2014;21(3):569-73.
http://www.ncbi.nlm.nih.gov/pubmed/24253195

Effectiveness of a novel and scalable CDS intervention to improve VTE prophylaxis: a quasi-experimental study

- 223,062 inpatients admitted between April 2007 and May 2010
- Baseline (period 1), and the time after implementation of the first CDS intervention (period 2) and a second iteration (period 3)
- CDS intervention was associated with an increase in "recommended" and "any" VTE prophylaxis across the multi-hospital academic health system
- The intervention was also associated with increased VTE rates in the overall study population, but a subanalysis using only admissions with appropriate POA documentation suggested no change in VTE rates
- Intervention was created in a commonly used commercial EHR and is scalable across institutions with similar systems.

Umscheid CA et al. *BMC Med Inform Decis Mak*. 2012; 31;12:92.
http://www.biomedcentral.com/1472-6947/12/92

Effectiveness of a novel and scalable CDS intervention to improve VTE prophylaxis: a quasi-experimental study

Table 5

Estimated increase in VTE prophylaxis use secondary to the clinical decision support

A. From time period 1 to time period 2

	Hospital A		Hospital B		Hospital C		Overall	
	Baseline	Increase	Baseline	Increase	Baseline	Increase	Baseline	Increase
Recommended (%)	31.5	3.2 (p=0.09)	34.5	6.7 (p<.01)	16.4	13.9 (p<.01)	27.1	7.9 (p<.01)
Any Prophylaxis (%)	55.0	10.3 (p<.01)	49.5	13.0 (p<.01)	65.5	6.6 (p<.01)	57.2	9.6 (p<.01)

B. From time period 1 to time periods 2 and 3

	Hospital A		Hospital B		Hospital C		Overall	
	Baseline	Increase	Baseline	Increase	Baseline	Increase	Baseline	Increase
Recommended (%)	30.9	3.7 (p=0.03)	34.5	5.4 (p=0.01)	16.4	13.6 (p<.01)	27.2	6.6 (p<.01)
Any Prophylaxis (%)	55.3	10.4 (p<.01)	49.5	14.6 (p<.01)	65.5	7.2 (p<.01)	57.5	9.6 (p<.01)

Abbreviations: VTE, venous thromboembolism.

Umscheid CA et al. *BMC Med Inform Decis Mak*. 2012; 31;12:92.
http://www.biomedcentral.com/1472-6947/12/92

Alert fatigue: A lesson relearned

It is amazing that technology forces us to relearn the same lessons over and over again at some considerable cost

— William A. Gouveia, M.S., DHL, FASHP

- Gouveia WA. Alert fatigue: A lesson relearned. *Am J Health Syst Pharm.* 2010;67(8):603-4.

Next Steps

The following are key areas where collaboration is needed to improve common alerts.

- *Alert content*
- *User interface*
- *Triggers*
- *Actions*
- *Performance*
- *Documentation and outcome assessment*
- *Interoperability*

Troiano D et al. The need for collaborative engagement in creating clinical decision-support alerts. *Am J Health Syst Pharm* 2013;70:150-153.

Triggers

- Medication characteristics (e.g., ingredients, generic name, therapeutic class, *AHFS Drug Information* class, controlled-substance schedule),
- Patient demographics (e.g., age, gender, actual body weight, ideal body weight, diagnosis, location of care delivery, clinical service),
- Clinical characteristics (diagnosis, indication for medication use, medical history, allergies, laboratory values),
- Trends in individual patient data (e.g., temporal analyses of laboratory values, calculated measures of organ function),
- EHR events (e.g., posting of laboratory values, entry of patient-specific information, charting of medication administration),
- Medication order details (e.g., dosage forms, administration routes, administration rates and frequencies),
- Place in workflow (e.g., order selection, entry, modification, discontinuance, administration),
- System user characteristics (e.g., service, years of experience, specialty), and
- Location and venue characteristics (e.g., emergency department, outpatient setting).

Troiano D et al. The need for collaborative engagement in creating clinical decision-support alerts. *Am J Health Syst Pharm* 2013;70:150-153.

Next Steps

- The potential for CDS common alerts for medications to have a major impact on the quality, safety, and cost of care has been demonstrated by numerous studies.
- In order to realize the promise of common alerts, health care organizations and drug knowledge base and EHR vendors must come together to substantially enhance alert capabilities:
  - alert systems need to be flexible
  - patient-specific
  - alerts reduce both false-positive and false-negative alerts
  - alerts should be in favor of useful information to clinicians
  - aid in the collection and maintenance of the tools to maintain these alerts

Troiano D et al. The need for collaborative engagement in creating clinical decision-support alerts. *Am J Health Syst Pharm* 2013;70:150-153.

Key Takeaways

- Key Takeaway #1
  - CDS is more than interruptive alerts
- Key Takeaway #2
  - Meaningful Use is driving adoption of EHRs and CDS is a component of the criteria
- Key Takeaway #3
  - Unnecessary alerts need to be monitored and removed to prevent Alert Fatigue

Questions

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CDS Governance: Why is it a necessary evil

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The World Before EHRs

- Pharmacy System was standalone system
  - Limited interfaces
    - ADT and Financial/Billing
  - Pharmacy Managed Formulary
    - Updates – New, Prices, Dispensing
    - Drug Shortages
- Paper Charts
  - Who has the chart?
  - Faxed orders or "people power"
- Phone Calls for changes and notifications

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The world according to the EHR

- Pharmacy system is integrated into the EHR or multiple interfaces into the EHR
  - Pharmacy teams work with multiple teams to make changes
  - Less nimble in times of crisis – Shortages and complex patients
- Providers have access to patient chart anywhere they have access to a computer, tablet, or smartphone
- Notifications occur within the EHR for critical labs, prescription refills, or order clarifications
- Patient portals enable communication to providers

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The Reality

- Coordination of changes to the EHR must be evaluated to ensure patient safety
  - Changes may need to be coordinated in more than one system
    - Pharmacy: ADCs, Carousels, IV Workflow, Inventory Management, surveillance software, etc.
  - Workflow needs to be evaluated
    - Prescribers, nursing, pharmacy, others
  - Reporting may be affected by change
    - Quality Measures, CMS, MU, etc.

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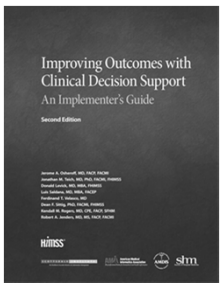
Resources



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How-To Guides for Clinical Decision Support (CDS) Implementation

- Guide 1- Start with a Strong Foundation for CDS: Provides steps and resources to help organizations decide whether or not to use CDS as part of a quality improvement initiative.
- Guide 2- Assemble a CDS Implementation Team: Helps organizations understand the roles necessary to implement CDS and to begin planning for acquiring or developing and implementing CDS interventions.
- Guide 3- Plan for Successful CDS Development, Design, and Deployment: Helps match CDS interventions to the work processes and goals of the organization.
- Guide 4- Roll Out Effective CDS Interventions: Offers recommendations for roll-out planning and for training. These activities help to ensure a smooth transition between planning and roll-out, or going live.
- Guide 5-Measure Effects and Refine CDS Interventions: Provides steps to ensure that the effects of interventions are appropriately measured and monitored. This includes measures reported to external agencies and feedback about usability from individual clinicians.

http://www.healthit.gov/policy-researchers-implementers/cds-implementation

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Key Steps to Assembling an Implementation Team

- Step 1: Understand the stakeholder roles required for successful implementation
- Step 2: Recruit Implementation Team Members and Cultivate Clinical Champions
- Step 3: Collaborate with outside sources to fill gaps in the implementation team
- Step 4: Convene the implementation team to begin planning

http://www.healthit.gov/sites/default/files/3-4-2-assemble-cds-implem-team.pdf

Signs of Readiness for Roll-Out

- ✓ The selected clinical objectives are seen as important to the key stakeholders within the organization
- ✓ Hardware, software, and technical staff to implement and support CDS are in place
- ✓ Intervention(s) selected to help achieve a clinical goal are matched to workflow and accepted by end-users
- ✓ Intervention has been tested to ensure it performs the intended function at the appropriate point in workflow
- ✓ Future usability and workflow issues anticipated and a mechanism for capturing and responding to clinician feedback is defined
- ✓ A plan has been made for management and updating of clinical content

http://www.healthit.gov/sites/default/files/3-4-3-successful-cds.pdf

Key Steps toward Achieving the Capacity for CDS

- Step 1: Select clinical goals that will guide selection of CDS interventions
- Step 2: Consult with EMR system designers and vendors about ways CDS might help to improve your clinical goals and related objectives.
- Step 3: Select CDS interventions to achieve clinical goals and objectives
- Step 4: Specify baseline measures for the objectives to be addressed by selected CDS interventions

http://www.healthit.gov/sites/default/files/3-4-3-successful-cds.pdf

Key Steps toward Achieving the Capacity for CDS

- Step 5: Map out current workflows and clinical processes affected by CDS interventions
- Step 6: Have a system for keeping interventions and knowledge current
- Step 7: Take steps to ensure the usability of your intervention(s)
- Step 8: Test intervention(s) for their effects on workflow and usability

http://www.healthit.gov/sites/default/files/3-4-3-successful-cds.pdf

Key Steps to Effectively Rolling out CDS

- Step 1: Create a roll-out plan
- Step 2: Communicate roll-out plan to end-users and stakeholders
- Step 3: Train end-users in the proper use of the intervention
- Step 4: Roll-out CDS interventions with support structures in place

http://www.healthit.gov/sites/default/files/3-4-4-rollout-effective-cds.pdf

Key Steps to Measuring the Effects of CDS Intervention

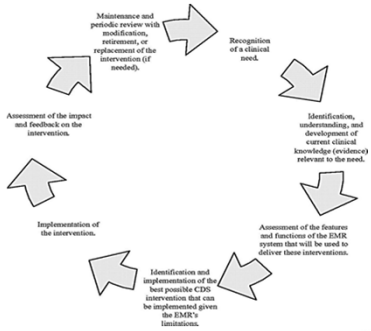
- Step 1: Assess CDS use and usability on an ongoing basis
- Step 2: Collect and report intervention performance against clinical goals and objectives
- Step 3: Use measurement results and feedback to refine CDS interventions
- Step 4: Involve end-users in CDS intervention enhancements; communicate changes back to end-users and ensure continued support

http://www.healthit.gov/sites/default/files/3-4-5-measure-effects-and-refine-cds-interv.pdf

Recommended practices for content management

- Delineate the knowledge-management life cycle
- Develop tools to facilitate content management
- Enable ongoing measurement of acceptance and effectiveness of CDS interventions
- Implement user-feedback tools that encourage frequent end-user input

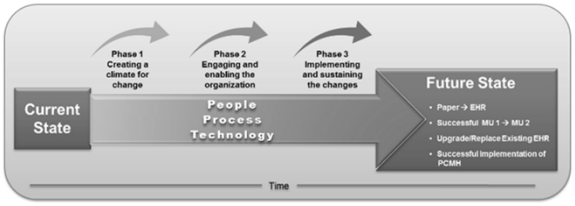
Knowledge-management life cycle



Adam Wright et al. *J Am Med Inform Assoc* 2011;18:187-194.

Project Management and Change Control

Kotter's Three - Phased Approach to Managing Change



https://www.healthit.gov/sites/default/files/tools/nlc_changemanagementprimer.pdf

Tools for Change Management

- Microsoft SharePoint
- Home Grown Tracking Software
- Microsoft Access
- Other Proprietary Software

Questions to Consider in Selecting Specific Clinical Goals – Group Discussion

- Which conditions are the high priority conditions in our community?
- How is our organization performing in the care of patients with these conditions? Can we identify a gap in care processes relative to guidelines?
- Are these gaps in care amenable to IT-based interventions? Is CDS the appropriate tool for improving performance?
- Are we obligated to report quality measures for specific conditions? Are there any incentives for improving our performance on these measures? Are we already reporting these measures, and could we develop a ready baseline of performance on these measures before CDS roll out?

http://www.healthit.gov/sites/default/files/3-4-3-successful-cds.pdf

Key Takeaways

- Key Takeaway #1
  - Change is inevitable, so your organization needs a strategy
- Key Takeaway #2
  - Even a small change can have a big impact in your system: Financially, operationally, or patient safety
- Key Takeaway #3
  - Communication and reassessment are key contributors to a successful CDS intervention

Questions

CDS and Transitions of Care

Van Do, Pharm.D.
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Section Overview

- Transitions of care overview
- Implementing CDS
  - Understanding your target
  - Systems of modeling
  - Selecting your CDS intervention
- Applying CDS fundamentals

Transitions of Care Introduction

- Transitions of care: "movement of patients between health care practitioners, settings, and home as their condition and care needs change"
- Ineffective care transition processes lead to adverse events and higher hospital readmission rates and costs (Forster et al, Rutherford et al)
- 80 percent of serious medical errors involve miscommunication during the hand-off between medical providers (Solet et al)

Forster A et al. *J Gen Intern Med.* 2005;20(4):317-323. Solet D et al. *Academic Medicine.* 2005;80(12):1094-1099. Rutherford P et al. How-to Guide: Improving Transitions from the Hospital to Community Settings to Reduce Avoidable Rehospitalizations. Institute for Healthcare Improvement June 2013. Available at www.IHI.org.

Small Group Discussion

- What problems are you facing implementing programs to improve transitions of care?
- With regards to implementing CDS, what do you think is special about transitions of care?

Transitions of Care CDS Concerns

- Patient involvement
  - Logistics of patient movement
  - Education
  - Ancillary services
- Interoperability
- Interdisciplinary
- "Trust"
- Limited pharmacist resources

Improving Transitions Of Care With Health Information Technology. 2010. http://www.ntocc.org/Portals/0/PDF/Resources/HITPaper.pdf

What is your favorite CDS tool?

A. Order sets
B. Asynchronous Alerts
C. Dashboards
D. Synchronous Alerts
E. Smart Forms
F. Other

A Public Service Announcement

"if all you have is a hammer, everything looks like a nail"

Maslow A. *Psychology Of Science*. [S.l.]: Harper & Row; p 15.

A Public Service Announcement

So where do we begin?

Assessing Your CDS Options

- **Inventory**: Create an inventory of CDS options
- **Model**: Understanding the workflow
- **Apply**: Apply "Five Rights" and intervention types

CDS Inventory

- Good starting point (Osheroff et al): Table 1-1, Table 1-2
  - https://goo.gl/gTwsYy
- Supplement with:
  - EHR vendor information
  - Experience
- Other factors to keep in mind (project team):
  - Upfront costs of implementation
  - Maintenance costs

Section 4 - Types of CDS Interventions | AHRQ National Resource Center; Health Information Technology: Best Practices Transforming Quality, Safety, and Efficiency. 2015. https://healthit.ahrq.gov/ahrq-funded-projects/clinical-decision-support-initiative/chapter-1-approaching-clinical-decision/section-4-types-cds-interventions.

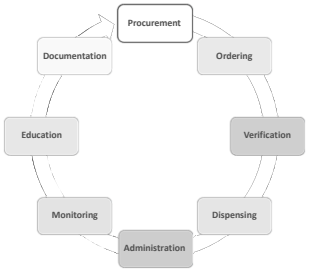
Table 1.2: Using CDS to Improve Medication Use and Outcomes

		MEDICATION MANAGEMENT CYCLE STEPS					
CDS FIVE RIGHTS	WHY (GOAL)	Optimize: EBM/Quality/ Regulatory, Cost, Safe Transition	Safer Use: DDI, dosing, allergies, etc.	Safety/ Appropriateness Check	Safe Administration	Optimize Patient Self-Care	Track Intention/ Unintentional Effects
	WHEN (WORK FLOW)	Reconcile/Select	Prescribe/Order	Verify/Dispense	Administer	Educate	Monitor
	WHO (PERSON)	Prescriber, Nurse, Pharmacist, (Patient)	Prescriber	Pharmacist	Nurse, Other Clinician, (Patient)	Clinicians, Patient	Clinicians, Patient, Health System
	WHAT (INFOR MATION)	Reference on drugs (selection, dosing, ID, pricing, etc.), diseases (treatment), condition-specific recommendations	Condition-specific Order Sets and Order Sentences; Order Checks and References	Reference/alerts on dosing/interactions	Reference information (e.g., administration, IV compatibility)	Patient-oriented reference (drug, disease, lab)	Reference drugs (effects monitoring), Diseases (course), Labs (interpretation); Effect monitoring
	HOW (FORMAT)	Order Sets, Reference (lookup/ InfoButton)	Reference (lookup/ InfoButton), Order Sets/Sentences	Reference (lookup/ InfoButton), Unsolicited alerting	Reference (lookup/ InfoButton)	Reference (lookup/ InfoButton)	Reference (lookup/ InfoButton); Rule checking/ unsolicited alerting/ relevant data
	WHERE (CHANNEL)	Internet, EMR/CPOE, Mobile, Med Rec Applications, Formulary Tools	CPOE, EMR, Internet, Mobile, Paper/electronic Order Forms	Pharmacy system, Internet, EMR	eMAR, EMR, Bar coding, Dispensing cabinets, IV pumps, Internet, Mobile, PHR	Internet, EMR, PHR	EMR/Surveillance systems, PHR, Internet, Mobile

Section 4 - Types of CDS Interventions. https://healthit.ahrq.gov/ahrq-funded-projects/clinical-decision-support-initiative/chapter-1-approaching-clinical-decision/section-4-types-cds-interventions.

Models – Pharmacy Informatics Domains

Models – Medication Use Cycle



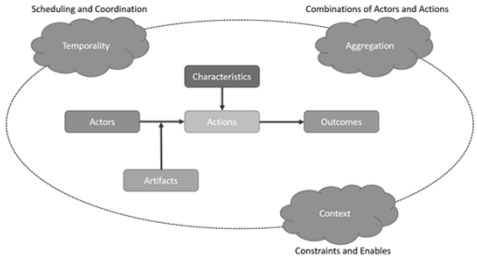
Adapted from: Osheroff JA, Pifer EA, Teich JM, et al. Improving outcomes with clinical decision support: an implementer's guide. Boca Raton: Productivity Press; 2005

Modeling – Other Fields

- Business Process Model and Notation (BPMN)
- Unified Modeling Language (UML)
- Workflow Elements Model (WEM) (Unertl et al)

Figure 3 In: Unertl K, Novak L, Johnson K, Lorenzi N. Traversing the many paths of workflow research: developing a conceptual framework of workflow terminology through a systematic literature review. *Journal of the American Medical Informatics Association*. 2010;17(3):265-273.

Workflow Elements Model (WEM)



Adapted from Figure 3 In: Unertl K et al. *Journal of the American Medical Informatics Association*. 2010;17(3):265-273.

Electronic Clinical Quality Improvement (eCQI)

- Office of the National Coordinator for Health Information Technology (ONC) provided resources
  - eCQI essentials worksheet (inpatient/outpatient)
  - eCQI enhanced worksheet (inpatient/outpatient)
- URL: http://www.healthit.gov/providers-professionals/planning-and-implementing-improved-care-processes

Applying The Tools

❖ eCQI **essential** worksheet overview

National Learning Consortium

eCQI Approach Summary[1]

	Pre-Admission/ Not Admission-related	Emergency Department/ Registration	History/ Assessment/ Documentation	Care Planning/ Patient Education/ Shared Decisions	Ordering	Care Plan Execution/ Monitoring	Discharge/ Transfer	Post-Discharge	Outside Encounters [Population management]	Founda-tional Work
Current Information flow										
Potential Enhancements										

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Essential Version). 2015. Available at: http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Essential-05-15.pdf. Accessed August 9, 2015.

Applying The Tools

Detailed Inpatient eCQI Worksheet

What Are We Trying To Improve? How Are We Doing Today?

Target* =	
Current Performance on	

eCQI Approach Details

Decision Support Opportunity [1]			Optimal State [a] (sample activities to optimize performance)			Current State [b] (Your current CDS/QI configuration)						Potential Enhancements [c]	
			Care Activities [2]	Examples of Care Activities [3]	Notes [4]	CDS 5 Right(s): Who? [6] (people)	What? [7] (information)	Where? [8] (channels)	How? [9] (Formats)	When? [10] (Workflow)	Notes [11]	Proposed Enhancements [12] (locally or by EHR Vendor)	Notes [13]
Patient specific Activities	Not Admission-related [14]												
	Pre-hospitalization [15]												
	Emergency Department [17]												
	During Hospitalization [18]	Registration/ eState [19]											
		History/ Assessment [20]											
		Documentation [21]											

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Enhanced Version). 2015. http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Enhanced-05-15.pdf.

eCQI Enhanced Worksheet

Decision Support Opportunity		
Patient specific Activities	Not Admission-related	
	Pre-hospitalization	
	Emergency Department	

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Enhanced Version). 2015. http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Enhanced-05-15.pdf. Accessed August 9, 2015.

eCQI Enhanced Worksheet

Decision Support Opportunity		
Patient specific Activities	During Hospitalization	Registration/Intake
		History/Assessment
		Documentation

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Enhanced Version). 2015. Available at: http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Enhanced-05-15.pdf. Accessed August 9, 2015.

eCQI Enhanced Worksheet

Decision Support Opportunity		
Patient specific Activities	During Hospitalization	Care planning/Patient Education/Shared Decisions
		Ordering
		Care Plan Execution
		Results/Monitoring/New Events
		Discharge/Transfer
	Post-discharge	
Population oriented Activities	Outside Patient-specific Encounters	

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Enhanced Version). 2015. Available at: http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Enhanced-05-15.pdf. Accessed August 9, 2015.

eCQI Enhanced Worksheet

Optimal State [a] (sample activities to optimize performance)		
Care Activities [2]	Example of Care Activities [3]	Notes

Current State [b] (current CDS/QI configuration)				
CDS 5 Rights [5]				
Who? [6] (people)	What? [7] (information)	Where? [8] (channels)	How? [9] (Formats)	When? [10] (Workflow)

Potential Enhancements [c]
Proposed Enhancements [12] (locally or by EHR vendor)

Health IT-Enabled Quality Improvement [eCQI] Worksheet (Inpatient, Enhanced Version). 2015. Available at: http://www.healthit.gov/sites/default/files/cds/eCQI-Worksheet-Inpatient-Enhanced-05-15.pdf. Accessed August 9, 2015.

Example of CDS in Transitions of Care

- AHRQ funded study (Duke)
- Target: Care transitions into ambulatory care for complex patients
  - Hospital discharge
  - Emergency department (ED) discharge
  - Specialty care referrals
- Using an existing regional health information exchange (HIE) network serving Medicaid beneficiaries in North Carolina
- Developed a Web-based service clinical decision support system (CDSS) application

Eisenstein E. *Improving Care Transitions For Complex Patients Through Decision Support*. 2012. Available at: https://healthit.ahrq.gov/sites/default/files/docs/activity/r18hs017795-eisenstein-annual-summary-2012.pdf. Accessed August 14, 2015.

Example of CDS in Transitions of Care

- Intervention:
  - When the CDSS detected a transition of care:
    - Care event summary reports faxed or emailed to the patient's medical home
    - Patient letter summarizing care sent
    - Release of information requests sent to the health information management department of the care encounter site on behalf of the patient's medical home
    - Care event notices emailed to the patient's assigned care manager

Eisenstein E. *Improving Care Transitions For Complex Patients Through Decision Support*. 2012. Available at: https://healthit.ahrq.gov/sites/default/files/docs/activity/r18hs017795-eisenstein-annual-summary-2012.pdf. Accessed August 14, 2015.

Example of CDS in Transitions of Care

- Study Design:
  - 1 year study in 2012 in 6 counties in North Carolina
  - Randomized controlled trial:
    - 1. Information on care transitions sent to patients and clinic-based caregivers
    - 2. Information on care transitions sent to patients, clinic-based caregivers, and care managers
    - 3. No information is sent
- Outcome measures:
  - Outpatient utilization rates
  - Emergency department utilization rates
  - Hospital utilization rates
  - Economic impact vs. usual care

- Eisenstein E. *Improving Care Transitions For Complex Patients Through Decision Support*. 2012. Available at: https://healthit.ahrq.gov/sites/default/files/docs/activity/r18hs0177

Example of CDS in Transitions of Care

- Summary:
  - Author's conclusions:
    - The decision support system was able to detect care transitions for complex patients
    - Able to integrate CDS with regional HIE
    - Only 60 percent of the information directed to providers available and in patient charts when follow-up visits for complex patients occurred
  - Results:
    - No significant difference in primary outcomes detected in this study

Case – Small Group Activity

- At your hospital, you are hoping to improve discharge counseling and pharmacy concierge services. Currently you have one unit with medication reconciliation pharmacists, but would like to expand their area of coverage to a larger pool of patients.
- In light of limited pharmacist resources, how do you use CDS in order to optimize the expansion of this service?
- Use the eCQI enhanced worksheet

Case – Small Group Activity

- **Report back:**
  - What are you targeting?
  - What CDS tools are you using?
  - Comments on worksheet

Key Takeaways

- **Develop a standardized process for CDS design**
  - Use the eCQI worksheet or develop your own
- **Use models**
  - Use models to optimize when and where a CDS intervention should take place
- **Do not fall in love with a single CDS tool**
  - Fully explore and utilize your entire tool kit

Questions?

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CDS and Population Health

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Section Overview

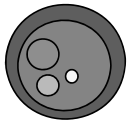
- Population health overview
- CDS and population health
  - Mechanics
  - Quality measures
- Applying CDS fundamentals

Small Group Discussion

- What is your definition of population health?
- What is the role of CDS in population health?

Population Health Introduction

- What is a population?
  - Members of a health plan
  - Admissions to a hospital
  - Patients with a disease
  - People in a city/state/country/planet
- What is population health?
  - Treating everyone?
- Who practices population health?



Krall M, Gundlapalli A, Samore M. In: Greenes R, ed. Clinical Decision Support. 2nd ed. Boston: Academic Press; 2015:363-379.

CDS and Population Health

- ❖ Population "diagnosis"
  - Tracking adverse events
  - Evaluation of practice variation
  - Analysis of quality of care
  - Outbreak detection
  - Measurement of outcomes
- ❖ Population "treatment"
  - Specific actions to address the diagnoses
  - "learning health care system"

Institute of Medicine, 2007. The learning healthcare system. In: Olsen, L.A., Aisner, D., McGinnis, J.M. (Eds.), The Learning Healthcare System: Workshop Summary, Washington (DC).
Krall M, Gundlapalli A, Samore M. In: Greenes R, ed. Clinical Decision Support. 2nd ed. Boston: Academic Press; 2015:363-379.

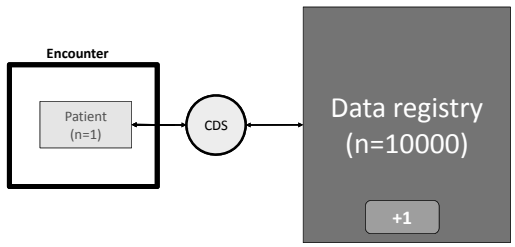
CDS and Population Health

- ❖ The importance of data in population health
  - Data collection
  - Data storage – registries
  - Data analysis
  - "Big Data"

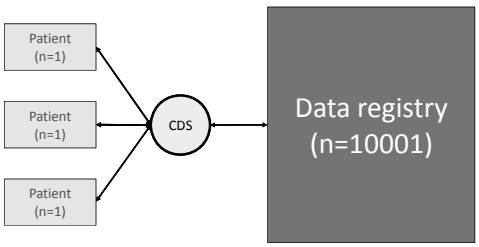
Data

Institute of Medicine, 2007. The learning healthcare system. In: Olsen, L.A., Aisner, D., McGinnis, J.M. (Eds.), The Learning Healthcare System: Workshop Summary, Washington (DC).

CDS and Population Health

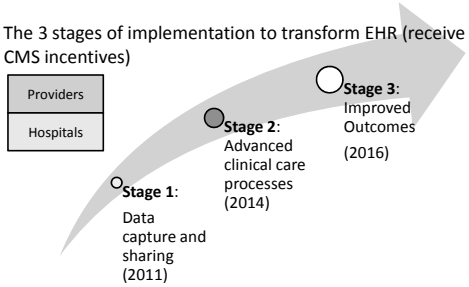


CDS and Population Health



Meaningful Use

- ❖ The 3 stages of implementation to transform EHR (receive CMS incentives)



Meaningful Use Definition and Meaningful Use Objectives of EHRs. 2015. Available at: http://www.healthit.gov/providers-professionals/meaningful-use-definition-objectives. Accessed August 11, 2015.

Meaningful Use

Certified EHR
+ core objectives
+ menu objectives

Clinical Quality Measures (CQMs)

Meaningful Use Definition and Meaningful Use Objectives of EHRs. 2015. Available at: http://www.healthit.gov/providers-professionals/meaningful-use-definition-objectives. Accessed August 11, 2015.

Clinical Quality Measures (CQMs)

❖ Measures:
- Health outcomes
- Clinical processes
- Patient safety
- Efficient use of health care resources
- Care coordination
- Patient engagements
- Population and public health
- Adherence to clinical guidelines

Clinical Quality Measures Basics. 2015. Available at: https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/ClinicalQualityMeasures.htm. Accessed September 5, 2015.

National Quality Strategy (NQS) Domains

NQS Domains	
Patient and family engagement	Population/public health
Patient safety	Efficient use of health resources
Care coordination	Clinical Process/Effectiveness

Clinical Quality Measures Basics. 2015. Available at: https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/CQM2014_GuideEH.pdf. Accessed September 5, 2015.

Creating the Quality Measure Equation

$$\frac{\text{Numerator}}{[\text{Denominator} - \text{Denominator Exclusions}] - \text{Denominator Exceptions}}$$

❖ Components of a proportion measure:
- Initial patient population
- Denominator
- Denominator exclusion
- Numerator
- Denominator exception

Eisenberg F. In: Greenes R, ed. *Clinical Decision Support*. 2nd ed. Boston: Academic Press; 2015:148-152.

Creating the Quality Measure Equation

$$\frac{\text{Measure Observations}}{[(\text{Measure population}) - \text{Exclusions}]}$$

❖ Components of a continuous variable measure:
- Measure observations
- Measure population
- Exclusions

Eisenberg F. In: Greenes R, ed. *Clinical Decision Support*. 2nd ed. Boston: Academic Press; 2015:148-152.

Clinical Quality Measures (CQMs)

❖ In Stage 2 – hospitals must report on 16 CQMs in three different NQS domains. Example:

Measure	Numerator Statement	Denominator Statement	NQS Domain
Emergency Department (ED)- 1 Emergency Department Throughput – Median time from ED arrival to ED departure for admitted ED patients	Median time (in minutes) from ED arrival to ED departure	All ED patients admitted to the facility from the ED and stratified according to Inpatient Admission or Diagnosis of Psychiatric/Mental Health condition	Patient and family engagement

Clinical Quality Measures Finalized for Eligible Hospitals and Critical Access Hospitals Beginning With FY 2014. 2014. https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/2014_CQM_EH_FinalRule.pdf. Accessed September 5, 2015.

Clinical Quality Measures (CQMs)

❖ Example:

Measure	Numerator Statement	Denominator Statement	NQS Domain
Stroke-2 Ischemic stroke – Discharged on antithrombotic therapy	Ischemic stroke patients prescribed antithrombotic therapy at hospital	Ischemic stroke patients.	Clinical Process/ Effectiveness

Clinical Quality Measures Finalized for Eligible Hospitals and Critical Access Hospitals Beginning With FY 2014. 2014. https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/2014_CQM_EH_FinalRule.pdf. Accessed September 5, 2015.

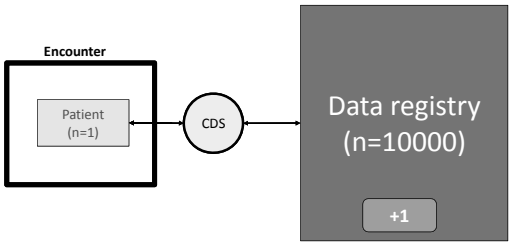
Million Hearts Initiative

- Preventing one million heart attack and strokes (2012-2017)
  - **A**spirin
  - **B**lood pressure
  - **C**holesterol
  - **S**moking cessation
- URL: http://millionhearts.hhs.gov/

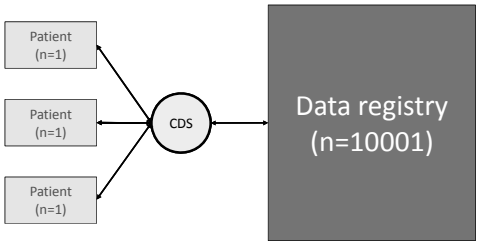
Million Hearts®

Frieden T, Berwick D. The "Million Hearts" Initiative — Preventing Heart Attacks and Strokes. New England Journal of Medicine. 2011;365(13):e27.

CDS and Population Health



CDS and Population Health



Case – Small Group Activity

- You are a large hospital system with both outpatient clinics and pharmacies. This Fall you would like to improve flu vaccination rates prior to the peak of flu season.
- How would you use CDS to optimally accomplish this task?
- Create a quality measure equation to evaluate your intervention
- Refer to the eCQI enhanced worksheet

Case – Small Group Activity

- **Report back:**
  - What is your population?
  - What CDS tools are you using?
  - What are you measuring?

Key Takeaways

- **Use the same standardized process** for CDS implementation with population health
- Population health interventions happen both **within and outside** of patient encounters
- **Target and develop quality measures**:
  - Help focus CDS interventions
  - Passive CDS that can drive population health management

Questions?

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PPMI and Complexity Score Index

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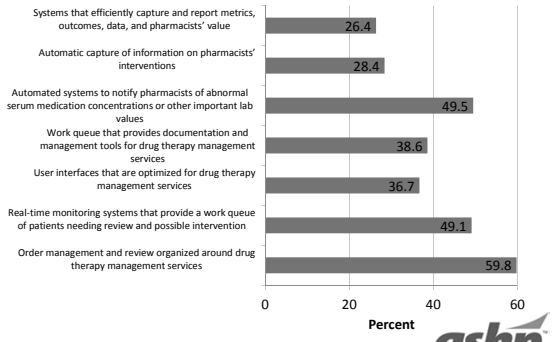
Pharmacy Practice Model Initiative

- Improve the health of patients by creating optimal practice models that allow pharmacists to effectively serve as patient care providers
- 6 PPMI objectives
  - Describe optimal practice models; identify core services; foster understanding and support; identify actions pharmacists should take; determine necessary tools
  - "Identify existing and future technologies required to support optimal pharmacy practice models in hospitals and health systems."
- Several technology solutions identified as important enablers of development of optimal pharmacy practice models

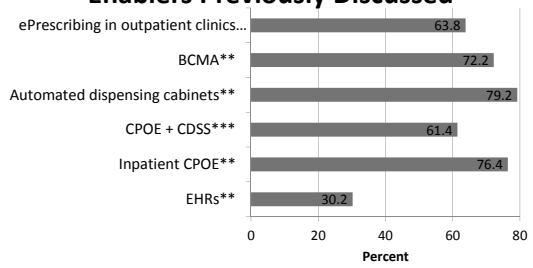
The consensus of the Pharmacy Practice Model Summit. *Am J Health-Syst Pharm.* 2011;68(12):1148-1152.
Executive summary. *American Journal of Health-System Pharmacy.* 2011;68(12):1079-1085.

Pharmacy Practice Model Initiative: Enablers*



*Of all hospitals

Pharmacy Practice Model Initiative: Enablers Previously Discussed



*Of hospitals with outpatient clinics; **Of all hospitals; ***Of hospitals that have CPOE

Pharmacy Practice Model Initiative: Takeaways – 2013 IT Survey

- Technology is an important enabler of developing a new practice model
- Considerable variation in adoption across technologies and hospitals
  - 9 found in >50%
  - 6 found in <50%
  - Larger vs. specialty and smaller
  - "Age" of technology ≠ greater adoption
- External factors
  - Meaningful Use
  - Leapfrog
  - Others

PPMI Pharmacy Practice Model Initiative (PPMI) National Dashboard

http://www.ashpmedia.org/ppmi/national-dashboard.html

PPMI

Pharmacy Practice Model Initiative (PPMI) National Dashboard

GOAL 4: Pharmacy departments utilize available automation and technology to improve patient safety and improve efficiency.

Measure	2014	2011
4.1. Percentage of hospitals/health systems using a computerized prescriber order entry (CPOE) system with clinical decision support for inpatient medication orders (e.g., rules that integrate order information, patient information, and clinical practice guidelines into computer system logic that provide feedback to prescribers). [C2b, C2d]	80.9%	34.2%
4.2. Percentage of hospitals/health systems that routinely use machine readable coding (e.g., bar coding technology with or without a robot) in the inpatient pharmacy to verify doses during dispensing. [C2j]	44.8%	33.9%
4.3. Percentage of hospitals/health systems that use automated dispensing technologies (e.g., automated dispensing cabinets, robotics). [C2k]	97.5%	N/S
4.4. Percentage of hospitals/health systems who have smart infusion pumps that are integrated into a closed loop medication-use process (i.e., where CPOE/pharmacy information system is integrated with pumps, and administration is documented on eMAR). [C2m]	8.0%	N/S
4.5. Percentage of hospitals/health systems that use machine-readable coding (e.g., Bar-Code Medication Administration [BCMA] system) to verify the identity of the patient and the accuracy of medication administration at the point-of-care. [C2l]	88.4%	50.2%

http://www.ashpmedia.org/ppmi/goal4.html

PPMI CDS Recommendations

- C2. *The following technology solutions in hospitals and health systems are important enablers in the development of optimal pharmacy practice models:*
  - C2d. Clinical decision support integrated with CPOE.
  - C2i. Automated systems to notify pharmacists when serum medication concentrations or other clinically important laboratory test values fall outside of a therapeutic or normal range.
  - C2o. Systems that efficiently capture and report pharmacy metrics, outcomes data, and pharmacists' value.
- C8. Human factors engineering principles should be employed to design and optimize safety, efficiency, and effectiveness of technology.

http://www.ajhp.org/content/68/12/1148.full.pdf+html

PPMI

Development and Validation of a Complexity Score to Identify Hospitalized Patients at High-risk for Preventable Adverse Drug Events

Objectives

1. To identify all prevalent hospital-acquired pADEs and to operationalize each for automated measurement using hospital billing and EHR data.
2. To identify a set of risk factors for each pADE based on published literature, medication error reports, and expert opinion and to operationalize each risk factor for automated measurement in EHR data with special focus on data elements defined under meaningful use to facilitate universal implementation.
3. To develop dynamic risk models for each pADE in pediatric and adult inpatient populations of two development hospitals, and to consolidate risk information of each model into a single Cscore that allows prioritizing specific pADEs according to individual preferences.
4. To validate the complexity score model in 13 testing hospitals with diverse geographic location, EHR systems, and case mix, and to provide fully-operationalized specifications for prospective and retrospective implementation.

http://www.ashpfoundation.org/MainMenuCategories/PracticeTools/Drug-Therapy-Management-Complexity-Score-Index

Comparison of Traditional Disease-Specific and Goal-Oriented Outcomes

Comparison of Traditional Disease-Specific and Goal-Oriented Outcomes.*

Measurement Domain	Examples of Diseases	Traditional Outcomes	Goal-Oriented Outcomes
Survival	Cancer, heart failure	Overall, disease-specific, and disease-free survival	None if survival not a high-priority goal; survival until personal milestones are met (e.g., grandchild's wedding)
Biomarkers	Diabetes, COPD	Change in indicators of disease activity (e.g., glycated hemoglobin level, CRP level, and pulmonary-function tests)	None (not a meaningful outcome observed or felt by patient)
Signs and symptoms	Heart failure, COPD, arthritis	Inventory of disease-specific signs and symptoms (e.g., dyspnea, edema, and back pain)	Symptoms that have been identified as important by the patient (e.g., control of dyspnea or pain sufficient to perform an activity such as bowling or walking grandchild to school)
Functional status, including mobility	Cancer, heart failure, COPD	Usually none or disease-specific (e.g., Karnofsky score, NYHA functional classification, and 6-minute walk test)	Ability to complete or compensate for inability to complete specific tasks identified as important by the patient (e.g., ability to get dressed without help)

* COPD denotes chronic obstructive pulmonary disease, CRP C-reactive protein, and NYHA New York Heart Association.

Reuben DB, Tinetti ME. N Engl J Med 2012;366:777-779.

Table 3. Characteristics of included studies on preventable adverse drug reactions among inpatients

Study (Country)	Study period	Study design	Population characteristics	Characteristics of patients with ADRs	Definition for ADR[1]	Criteria for preventability
Pearson 1994 [23] (United States)[2]	6 months, 1992–1993	Prospective, observational	No age limitation	Mean age unknown, 50% male	Similar to WHO [16]	Schumock [40]
Ghulami 1999 [41] (Iran)	4 months, 1996	Prospective, randomised for inclusion	No age limitation, range 10–86 years	Unknown	WHO [16]	Schumock [40]
Dormann 2004 [30] (Germany)[2]	12 months+6 months for related readmission, no year	Prospective, observational	Mean age 57 years (range 18–97), high proportion of those between 55–70 years	Unknown	WHO [16]	Schumock [40]
Banisasadi 2008 [42] (Iran)	12 months, 2006–2007	Prospective, interventional	No age limitation	Unknown	WHO [16]	Schumock [40]
Davies 2006 [43] (United Kingdom)	2 weeks, 2005	Prospective, observational	Median age 61 years (range 45–78), 51% male	Median age 70 years (range 52–79), 38% male	Edwards and Aronson [17]	Hallas [39]
Davies 2009 [44] (United Kingdom)	6 months, 2005	Prospective, observational	Median age of people without ADR 61 years	Median age 72 years, 49% male	Edwards and Aronson [17]	Hallas [39]
Pourseyed 2009 [45] (Iran)	15 weeks, 2004	Prospective, observational	Mean age 60 years (range 13–91), 78% between 40–79 years, 51% male	Mean age 54 years, 43% male	WHO [16]	Schumock [40]
Farcas 2010 [46] (Romania)	12 months, 2009	Prospective, observational	Mean age 59 years (range 25–92), 47% male	Mean age 65 years, 31% male	WHO [16]	Imbs [37]

ADR = adverse drug reaction; WHO = World Health Organization.
[1]Data from study used for analyses on preventable adverse drug reactions for both outpatients and inpatients.
[2]Studies using WHO's definition may have referenced another publication for the definition.
doi:10.1371/journal.pone.0033236.t003

Hakkarainen KM et al. (2012) Percentage of Patients with Preventable Adverse Drug Reactions and Preventability of Adverse Drug Reactions – A Meta-Analysis.
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0033236

Percentage of Patients with Preventable Adverse Drug Reactions and Preventability of Adverse Drug Reactions – A Meta-Analysis

- 2% of adult outpatients being hospitalized or visiting emergency care experience PADRs
- 50% of all ADRs among outpatients were preventable
- 50% of ADRs present during hospitalization for inpatients were preventable
- Implications
  - Meta-analysis corroborates that PADRs are a significant burden to healthcare among adult outpatients.
  - Among both outpatients and inpatients, approximately half of all ADRs are preventable.
  - Although preventability estimates vary across studies, our results demonstrate that further evidence on prevention strategies is required.
  - The percentage of patients with PADRs among inpatients and in primary care is largely unknown and should be investigated in future research.

Hakkarainen KM et al. (2012) Percentage of Patients with Preventable Adverse Drug Reactions and Preventability of Adverse Drug Reactions – A Meta-Analysis. PLoS One 2012;7(3):e33236

Other Scoring Measures

- Critical Care
  - Acute Physiology and Chronic Health Evaluation (APACHE)
  - Simplified Acute Physiology Score (SAPS)
  - Mortality Probability Model (MPM)
- Nursing

Acuity criteria categories

This chart shows the five acuity categories in the new acuity tool developed for the progressive care unit at Indiana University Health Ball Memorial Hospital. In each category, nurses rate each patient from 1 (lowest acuity) to 4 (highest acuity).

Acuity category	Examples of care required
Complicated procedures	1: Pulse oximetry, telemetry 2: Trach care, nasogastric tube, fall risk 3: Continuous bilphasic positive airway pressure, tracheostomy care, ostomy care, chest tube, peritoneal dialysis 4: Total care; restraints; confused, restless, combative
Education	1: Standard 2: New medications 3: Discharge today, pre- or postprocedure status 4: New diagnosis, multiple comorbidities
Psychosocial or therapeutic interventions	1: Three or fewer per shift 2: Three to five per shift 3: Six to 10 per shift; delirium; end of life 4: More than 10 per shift
Oral medications	1: One to five 2: Six to ten 3: 11 to 15 4: 16 or more
Complicated I.V. drugs and other medications	1: Glucometer with coverage 2: Two to five I.V. medications 3: Heparin protocol, more than five I.V. medications, total parenteral nutrition 4: Blood products, tube feeding, cardiac drug or insulin drip

http://www.americannursetoday.com/wp-content/uploads/2014/03/ant3-Workforce-Management-Acuity-304.pdf.
http://www.ccforum.com/content/14/2/207

Comparison of general outcome prediction models

Characteristics	APACHE [12]	SAPS [11]	APACHE II [4]	MPM* [14]	APACHE III [5]	SAPS II [11]	MPM II† [15]	SAPS 3 [12]	APACHE IV [6]	MPM III [17]
Year	1981	1984	1985	1985	1991	1993	1993	2005	2006	2007
Countries	1	1	1	1	1	12	12	35	1	1
ICUs	2	8	13	1	40	137	140	303	104	135
Patients	705	679	5,815	2,783	17,440	12,997	19,124	16,784	110,558	124,855
Selection of variables and their weights	Panel of experts	Panel of experts	Panel of experts	Multiple logistic regression	Multiple logistic regression	Multiple logistic regression	Multiple logistic regression	Multiple logistic regression	Multiple logistic regression	Multiple logistic regression
Variables										
Age	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin	No	No	No	No	Yes	No	No	Yes	Yes	No
Surgical status	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chronic health status	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Physiology	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acute diagnosis	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Number of variables	34	14	17	11	26	17	15‡	20	142	16‡
Score	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Mortality prediction	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*These models are based on previous versions, developed by the same authors. †The numbers presented are those for the admission component of the model (MPM_{0} II). ‡MPM_{0} II uses only 13 variables. §Plus 7 interaction terms. APACHE, Acute Physiology and Chronic Health Evaluation; SAPS, Simplified Acute Physiology Score; MPM, Mortality Probability Model. Adapted from [16] with permission.

Vincent and Moreno *Critical Care* 2010 **14**:207 doi:10.1186/cc8204

Group Exercise

- Discuss with your small group:
  - What are your primary challenges related to PPMI, CDS, and determining patient priority?
  - What has your organization done to address these issues?

Key Takeaways

- Key Takeaway #1
  - Technology is an important enabler of developing a new practice model
- Key Takeaway #2
  - Pharmacy can learn from other scoring tools for examples
- Key Takeaway #3
  - Preventable adverse drug events are common in both inpatient and outpatients, and organizations need tools to detect and prevent from causing severe harm to patients

Questions

Developing Dashboards

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Informatics Pharmacist
Oregon Health & Science University
Portland, OR

Section Overview

- Dashboard overview
- Dashboard design principles
- Show and tell

Dashboards Introduction

- Historical:
  - 1980s: Executive Information Systems (EIS)
  - 1990s: Data warehousing, online analytical processing, and business intelligence develop and mature
  - 1990s: Key Performance Indicators (KPIs)

Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:2-4.

Small Group Discussion

- What is a dashboard?

What is a Dashboard?

- A dashboard is a:
  - **Visual display**
  - **Most important** information needed to achieve one or more **objectives**
  - **Consolidated** on a single screen
  - Monitored **at a glance**
- Supporting attributes**:**
  - Present information using small, concise, direct, and **clear display media**
  - **Customized**

Few S. *Information Dashboard Design*. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:26-27.

What is a Dashboard?

- Goal is to help maintain **situational awareness**
  - Level 1: perception of elements in the environment
  - Level 2: comprehension of the current situation
  - Level 3: projection of future status
- Should not be used directly used for exploration, analysis and action

Few S. *Information Dashboard Design*. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:30-32.

Karsh B-T. Clinical practice improvement and redesign: how change in workflow can be supported by clinical decision support. AHRQ Publication No. 09-0054-EF. Rockville, Maryland: Agency for Healthcare Research and Quality. June 2009.

Performance Monitoring Process

1. Update high-level situation awareness
2. Identify and focus on items that need attention
   a) Update awareness of issue in greater detail
   b) Determine if action is required
3. If action required, get more information, determine response
4. Respond

Few S. *Information Dashboard Design*. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:32.

Dashboard Types

- Quality/Informational Dashboard
- Clinical Dashboard
- Operational Dashboard
- Financial Dashboard

Dashboard Evidence

- Dashboards for improving patient care: Review of the literature (Dowding et al)
- Included 11 studies of quality or clinical dashboards in a healthcare setting
  - 9 studies used a "traffic light" scheme
  - A lot of heterogeneity in where used and targeted users

Dowding D, Randell R, Gardner P et al. Dashboards for improving patient care: Review of the literature. International Journal of Medical Informatics. 2015;84(2):87-100.

Dashboard Evidence

- Batley et al. and Linder et al.
  - Both reported clinicians who used the dashboard were more likely to reduce inappropriate prescribing rates for antibiotics
  - Overall no difference with dashboard use due to proportion of individuals who chose not to use the dashboard

Dowding D, Randell R, Gardner P et al. Dashboards for improving patient care: Review of the literature. International Journal of Medical Informatics. 2015;84(2):87-100.

Dashboard Evidence

- Implementation of a Real-time Compliance Dashboard to Reduce VAP with the Ventilator Bundle (Zaydfudim)

Bed	Patient name	Age	LOS	Orders			SBT					Rass					
							Vent	Scrn	Trial	DVT	SUP	Ord	Pt	HoB	swab	teeth	hySa
3002b	XXX	72y	6d		flowsheet	MAR	v	F		v	v	-4	-4	30			
3003X	XXXX	60y	17d		flowsheet	MAR	v	F		v	v	0	-2	45			
3004B	XDFS	65y	20d		flowsheet	MAR	v			v	v	-1	-1	30			
3005B	EZZ	45y	5d		flowsheet	MAR	v			v	v		0	30			

Adapted from Figure 1 from: *Arch Surg*. 2009;144(7):656

Zaydfudim V. Implementation of a Real-time Compliance Dashboard to Help Reduce SICU Ventilator-Associated Pneumonia With the Ventilator Bundle. Arch Surg. 2009;144(7):656. doi:10.1001/archsurg.2009.117.

Dashboard Evidence

❖ Implementation of a Real-time Compliance Dashboard to Reduce VAP with the Ventilator Bundle (Zaydfudim)

- **Design:** VAP rates in SICU between January 2005 and July 2008, with dashboard implementation in July 2007 – set as screensaver
- **Results:**
  - Average compliance with the ventilator bundle improved from 39% in August 2007 to 89% in July 2008 ($P < .001$)
  - Rates of VAP decreased from a mean (SD) of 15.2 (7.0) to 9.3 (4.9) events per 1000 ventilator days after introduction of the dashboard ($P = .01$)

Dashboard Design Principles

❖ Fundamental Considerations:

Attribute	Items
Update Frequency	Real time Scheduled (hourly, daily, etc.)
User Expertise	Clinical, operational, technological
Audience Size	One person, multiple
Technology Platform	How and where?
Screen Type	Size
Data Type	Quantitative, non-quantitative

Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:65.

Dashboard Design Principles

❖ Visual perception concepts:

- Limits of working memory
- Encoding data for rapid perception
- Gestalt principles of visual perception

Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:78.

Dashboard Design Principles

❖ Types of memory:

- Iconic memory
- Working memory
  - Temporary
  - Portion dedicated to visual information
  - Limited capacity
- Long-term memory

Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:78.

Dashboard Design Principles

❖ Encoding data for rapid perception

- See for more: Ware C. Information Visualization. Boston: Morgan Kaufmann; 2012.
- Example:
  - FDFMSDKJEIFLEJGHEMCAFSFAOEJFHEFMDFH
    - ➢Color: FDFMSDKJEIFLEJGHEMCAFSFAOEJFHEFMDFH
    - ➢Size: FDFMSDKJEIFLEJGHEMCAFSFAOEJFHEFMDFH

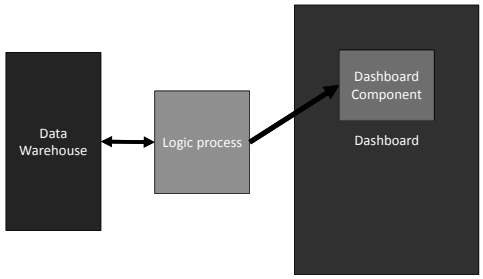
Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:79-85.

Dashboard Design Principles

- Gestalt principles of visual perception:
  - Proximity: *** *** ** **
  - Similarity: i.e. Using the same color
  - Enclosure: A B A B A B
  - Closure: [ ]
  - Continuity: - - - - - - - -
  - Connectio

Few S. Information Dashboard Design. 2nd ed. Burlingame, Calif.: Analytics Press; 2013:87.

Dashboard Mechanics



Dashboard Mechanics

- Rules are at the heart of every Dashboard
- Production rule/condition-action rule
  - IF (condition) THEN (action)
- A collection of rules and logic with time component
  - Real-time/Continuous
  - Triggered
  - Scheduled

Dashboard Providers

- Health care specific:
  - Electronic Health Record Vendors (ideal)
  - Sentri7®
  - TheraDoc
  - Micromedex 360 Care Insights
- Business intelligence:
  - SAP
  - Oracle
  - IBM

Case – Small Group Activity

- **Show and Tell:**
  - What dashboards are you using?
    - Dashboard type
    - Dashboard design principles

Operational Dashboards

- Operational example
  - IV room technician workload balancing
  - Metrics:
    - Time from label print to preparation (first dose)
    - Time from label print to preparation (batch)
    - Time from preparation to delivery

Operational Dashboards

Attribute	Items
Update Frequency	Real time
User Expertise	Operational
Audience Size	Multiple (Ops, IV room)
Technology Platform	TV monitor
Screen Type	1080p (50 inch)
Data Type	Mainly non-quantitative, but also quantitative

Current IV Room Status

First doses prepared (last hour): **15**	Batch doses prepared (last hour): **40**	Routine doses delivered (last hour): **35**
Time until prep: Hourly Avg: 20 minutes	Time until prep: Hourly Avg: 70 minutes	Time until delivery: Hourly Avg: 45 minutes

Key Takeaways

- A dashboard should:
  - Have a clear purpose
  - Be actionable
  - Be part of a workflow process
- When creating or evaluating dashboards use visual design principles to improve efficacy