

Embedding CDS in the EHR

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Disclosures


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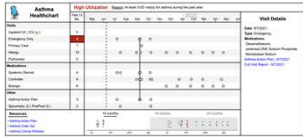
Overview

- Use cases
- A (brief) history of CDS
- Sociotechnical systems
- Implementation
- Review



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Use Cases



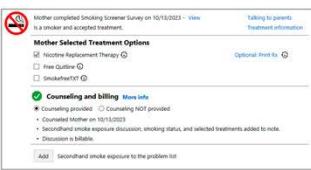
Asthma Medication

High Utilization: 3 days in last 120 days for asthma severity not met

Next Status: Not Entered

Medication: Albuterol Inhaler, Budesonide Inhaler, Salmeterol Inhaler, Fluticasone Inhaler, Montelukast Tablet

HealthQuest



Mother completed Smoking Cessation Survey on 10/13/2023 - View Talking to parents: Required information

Mother Selected Treatment Options

Nicotine Replacement Therapy Optional Print for: [X]

New Quitline [X]


Nicotinic Patch [X]

Counseling and Billing Items list

- Counseling provided: Counseling NOT provided
- Counseled Mother on 10/13/2023
- Secondhand smoke exposure discussion, smoking status, and selected treatments added to note.
- Discussion is SBAR.

ADD Secondhand smoke exposure to the problem list

Clinician Facing SMART App for Caregiver Smoking Cessation



What is CDS

“Clinical decision support (CDS) provides clinicians, staff, patients or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care.”¹






Figure from Blandish, 2014.²



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Why do we need CDS?


- Humans are fallible.³
- Estimated 98,000 deaths from medical errors each year.⁴
- Medical knowledge continues to grow at a rapid pace.

SPECIAL ARTICLE

PROTOCOL-BASED COMPUTER REMINDERS, THE QUALITY OF CARE AND THE NON-PERFECTIBILITY OF MAN

CLYDE J. McDONALD, M.D.





Does it Work?


Effects of Computerized Clinical Decision Support Systems on Practitioner Performance and Patient Outcomes
A Systematic Review

Annals of Internal Medicine | IMPROVING PATIENT CARE

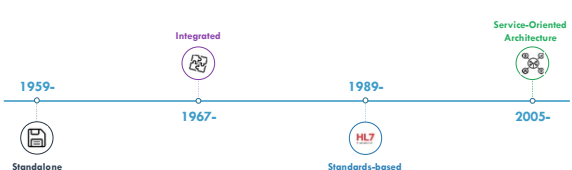
Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care

Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success

- Improves quality.⁵
- Reduces medical errors.⁶
- Implementation is key.⁷




Evolution of CDS

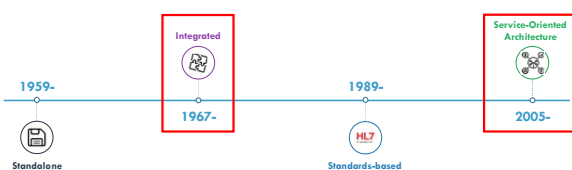


The timeline shows four stages of CDS evolution:


- 1959- Standalone:** Represented by a document icon.
- 1967- Integrated:** Represented by a person and a document icon.
- 1989- Standards-based:** Represented by an HL7 icon.
- 2005- Service-Oriented Architecture:** Represented by a network icon.



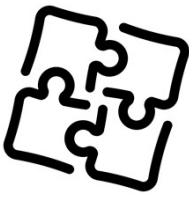
Evolution of CDS



This version of the timeline highlights the 'Integrated' (1967-) and 'Service-Oriented Architecture' (2005-) stages with red boxes.




Integrated Systems




- Advantages
 - Uses data already collected
 - Proactive
- Disadvantages
 - Knowledge management challenges
 - Limited shareability
- Examples:
 - HELP⁹, Regenstrief MRS, Vendor EHRs

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Service-Oriented Architecture



- Advantages
 - Reduces vocabulary issues
 - No restrictions on knowledge representation
 - Maintenance
- Disadvantages
 - Performance
 - Challenges reconciling information
 - Monitoring and support
- Examples:
 - SMART¹⁰, CDS Hooks¹¹

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Participation Points

What form of CDS is the best?

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EHR Configured CDS

Best Practice Advisory - ASAP_30000

↳ Suggestion (Advisory: 1)

✓ **Situation Awareness: High Risk Asthma Patient**

Jeremy ASAP is a high risk asthmatic based on at least 2 hospitalizations for asthma at CHOP during the past year.

Nursing and respiratory therapy should be notified through orders in the ED Asthma SmartSet. These orders are pre-selected.

If the patient is eventually discharged from the ED, include the Asthma High Risk Bundle (outlined below)

- Prescribe an Asthma Controller Med at ED discharge if not already prescribed
- Provide an Asthma Care Plan at discharge
- Send a Referral to ED Case manager to follow up with the family after discharge.

Orders will be included automatically in the Asthma Discharge SmartSet as a reminder.

The following actions have been applied:

✓ Sent This advisory has been sent via In Basket

⊘ Acknowledge Reason

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Clinical Expertise

What information do you need to treat asthma?

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Asthma Assessment

Visits

Medications

Social Determinants of Health


Patient Reported Outcomes

Procedures

Others


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But...is everything equal?




Admissions
ICU Visits
Sick vs Well

Visit Diagnosis
Billing Code
Order Set



Orders
Dispenses
Administrations

Name
Pharm Class
Ingredient



EHR Configured CDS

BestPractice Advisory ASAP_Jeremy

↳ Suggestion (Advisory: 1)

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Human Centered Design

“...an approach to interactive systems that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques”¹²





Sociotechnical Systems

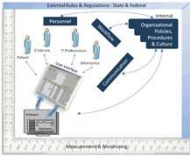


Figure from Singh and Singh (2010)








Figure from Carayon et al. (2020)


- Enumerate components of the health system.^{16, 17}
- Describe high-level connections.
- Focus on health information technology (HIT)




Hardware and Software

Where are the boundaries of the system?




Clinical Content




Where is the content coming from?

$f(x)$

Information transformation¹⁵



Is all information equally relevant?



Telephone Game

The diagram illustrates the Telephone Game process. It starts with a globe representing the original message. An arrow points to a doctor icon, then to a nurse icon, then to a receptionist icon, and finally to a sign icon. A return arrow points from the sign back to the globe, indicating the message's distortion.

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Human Computer Interface

- Requires iteration¹⁶
- Pay attention to “affordances”
- Follow established heuristics¹⁷

Past Medical History

Date	Visit Type	Department	Provider	Reason
02/06/2021	Office	Philadelphia Primary Clinic	Samantha Foster, MD	Well visit
03/01/2021	Office	Philadelphia Allergy	Franz, Basil, MD	Bumps on skin...
01/11/2021	Office	Philadelphia Allergy	Franz, Basil, MD	Rash
11/23/2021	Office	Philadelphia Primary Clinic	Tammy Reinhardt, CRNP	Flu shot
10/05/2020	Student	General Medicine	Daniel Hahn, MD	Respiratory distress
10/01/2021	Office	Philadelphia Primary Clinic	Wendy Linnert, MD	Ford poisoning
08/26/2020	Emergency	Philadelphia ED	Karen Galanos, MD	Fractured leg
05/14/2020	Office	Philadelphia Allergy	Herbert Gornow, MD	Asthma

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Data Representation

A

File Types = Density

B

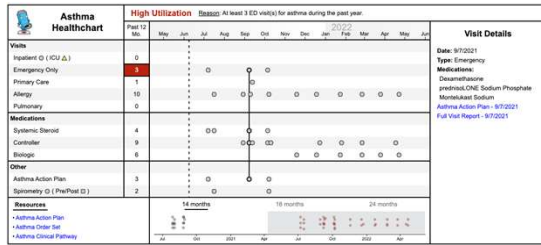
File Types = Shape

C

Which representation of file type is preferred?

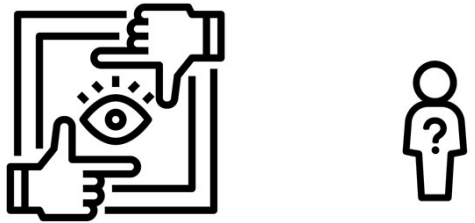
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Mental Model Alignment



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People



Different users have different needs and perspectives.

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People




Different users have different needs and perspectives.


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People




Different users have different needs and perspectives.




Clinicians




Patients



Technologists




Family




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Workflow and Communication




Work as imagined may not be the same as work as done¹⁹



Workflow, Workflow, Workflow²⁰





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Internal Pressures

- Policies
 - Data storage
- Procedures
 - Committees
- Culture²¹
 - Stability vs innovation




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External Rules, Regulations, and Pressures



Regulations²²




Economics




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Measurement and Monitoring




Changes in one area can impact other areas



Patient Process Technology




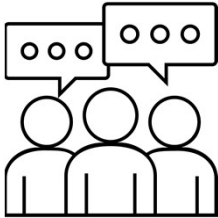
Never stops



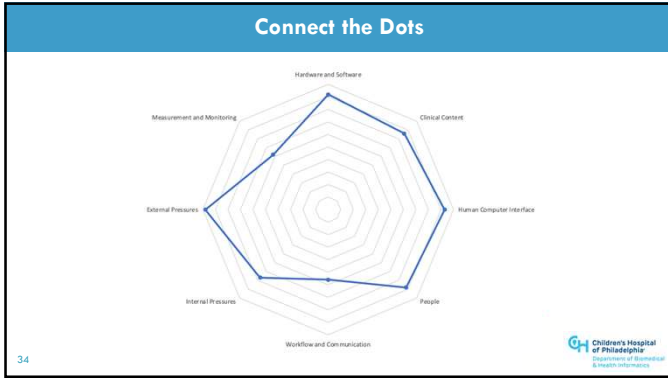
32 Reference: 23 - 25

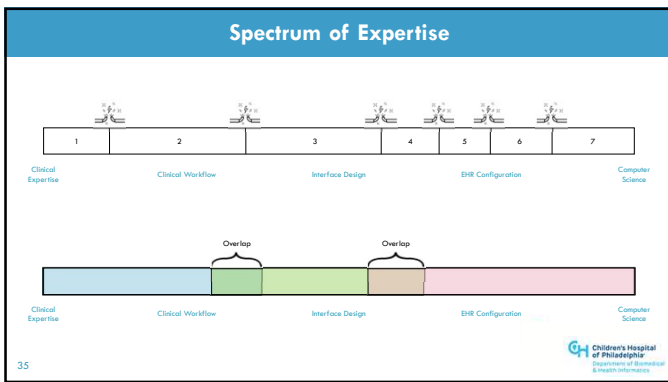
How to Operationalize

- Engage users early and often¹⁶
 - Observation
 - Interviews
- Learn by doing
- Failure Modes and Effects Analysis²⁶
- “Silent” deployments²³



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Review

- Start small
- Build support
- Engage a multi-disciplinary team
- Iterate rapidly




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Questions



Thank you
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