

Clinical Decision Support Systems (CDSS)

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Disclosures

- I receive research funding from FDA, NIDDK, NIMHD, NICHD and NCATS.
- I am a paid consultant for AI Health. AI Health played no role in the design, execution, analysis, or development of this work. AI Health did not play a role in the decision to prepare this presentation and had no editorial input.

Learning Objectives

- Describe clinical decision support systems (CDSS or CDS)
- Highlight the benefits of CDSS for patient care
- Evaluate use of CDSS for patient care in everyday settings
- Discuss use of CDSS for patient care in Armenia

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About Me



- General Pediatrician
- Board Certified Clinical Informaticist
- Co-Director, Clinical Research Informatics Core, SC CTSI
- Director, West Coast Consortium for Technology & Innovation in Pediatrics
- Research focused on patient generated health data, integration and interoperability, health equity, social determinants of health, obesity, and diabetes

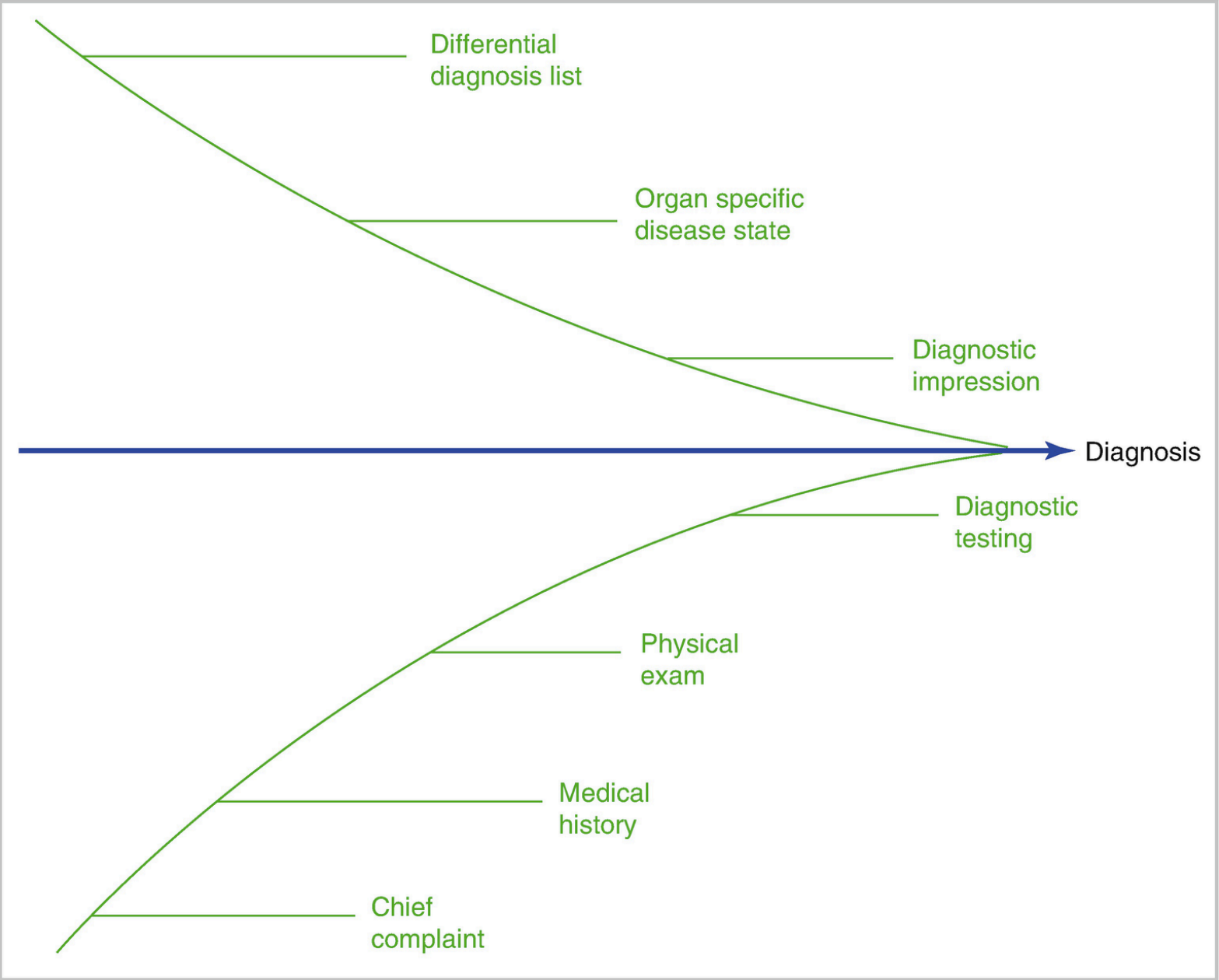
Clinical Decision Making

Clinical Decision Making

- All medical decisions involve uncertainty, many involve risk
 - Diagnosis, testing, natural course of disease, effects of treatment are rarely “certain”
 - Choosing which variables to consider when making a decision is a challenge
- Some factors have characterizable / measurable risk -> appeal of decision analysis

Sources of Decision Bias

- Diagnostic inference is a problem of “revising opinion with imperfect information” (Hunink, p151)
- Blois’ Funnel: Breadth of diagnostic considerations are refined, restricted over course of interaction between patient and practitioner (Blois, 1984)
- Making decisions based on opinion is subject to predictable patterns of bias



Common Heuristics and Biases

- **Availability**

- Overestimating probability of unusual events because of recent or memorable instances
- “The last patient I saw with symptom X had disease Y, so we should test for Y”

- **Representativeness**

- Overestimating rare diseases by matching patients to “typical picture” of that disease.
- “representative heuristic is insensitive to pretest probabilities” (Hunink, p.151)
- “He has features of the rare disease X, so we should test for it”
- The medical adage “when you hear hoofbeats, think horses, not zebras” is a warning against errors due to this heuristic

Common Heuristics and Biases

- **Ascertainment bias**
 - Thinking is shaped by prior expectation
 - Examples include stereotyping or gender bias
- **Confirmation bias**
 - Tendency to look for confirming evidence rather than disconfirming evidence to refute it.
 - “Cherry picking” results from a large set of negative results
- **Diagnosis momentum**
 - Things that are initially diagnostic considerations, as they are passed from clinician to clinician, become “stickier” and more certain

Common Heuristics and Biases

- **Anchoring**

- Failure to adjust probability of a disease or outcome based on new information
- “I was told in sign-out that he had condition X, so I didn’t consider it might be condition Y, despite lab result Z”

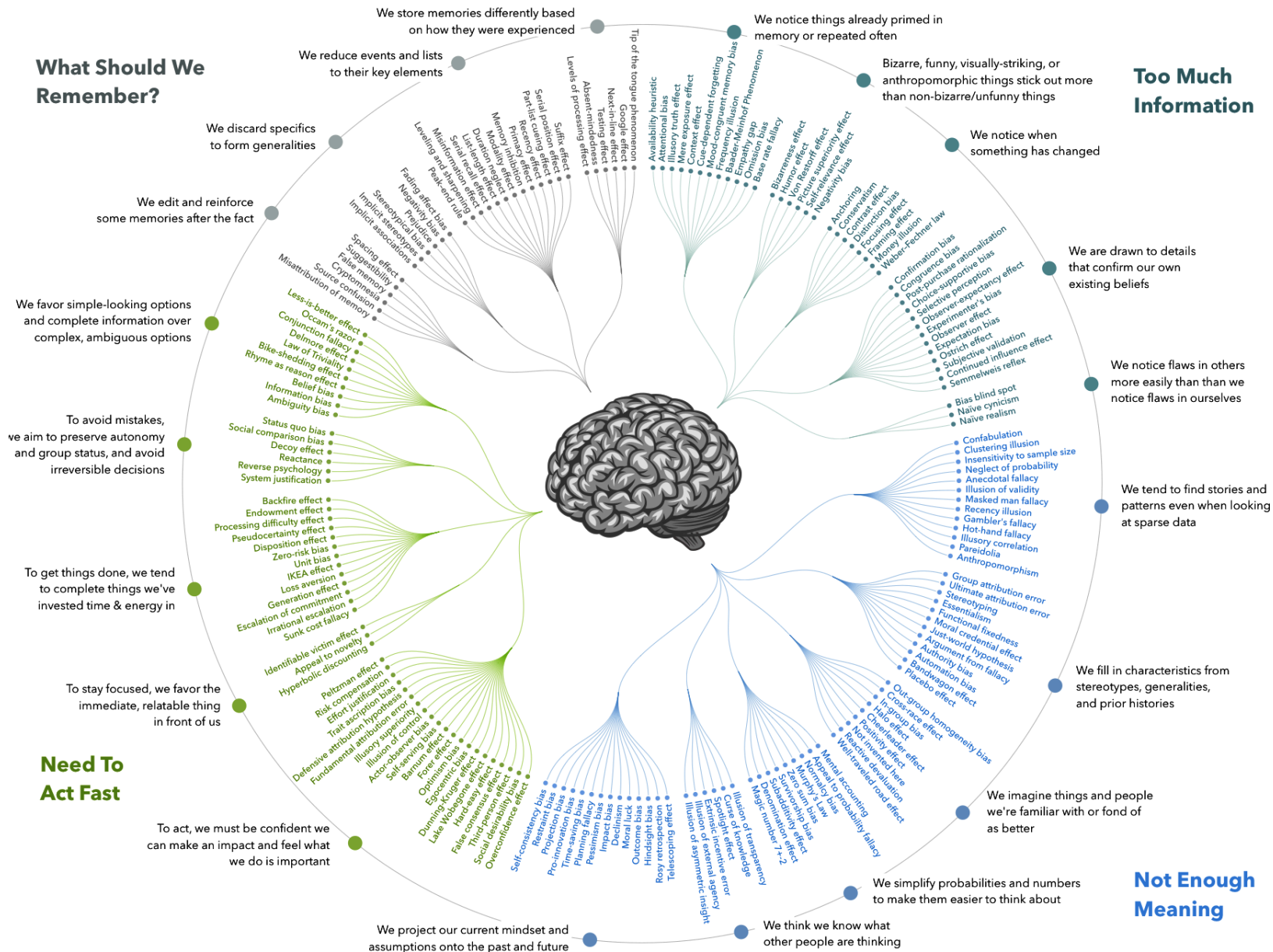
- **Premature Closure**

- Tendency to accept a diagnosis before it’s fully confirmed.
- “When the diagnosis is made, the thinking stops”

- **Value-induced bias**

- Overestimate probability of an outcome based on value associated with that outcome
- Ex: “It would be horrible to miss a brain tumor in this patient with new onset headache, so we should get a head CT”

COGNITIVE BIAS CODEX



Combating Cognitive Bias

Strategy
Develop insight/awareness
Consider alternatives
Metacognition (“thinking about how you think”)
Decrease reliance on memory
Specific training
Simulation
Cognitive forcing strategies
Make task easier
Minimize time pressures
Establish accountability
Feedback about diagnostic errors

Introduction to CDSS

Video Time!

Informatics 101: Understanding Clinical Decision Support
Vanderbilt School of Nursing

August 28, 2019

<https://www.youtube.com/watch?v=p3kpHKMxrbA>

Definitions

Most restrictive:

- an electronic system that provides structured guidance based on patient-specific inputs
 - *Expert systems*
 - *Conditional alerts*

Less restrictive:

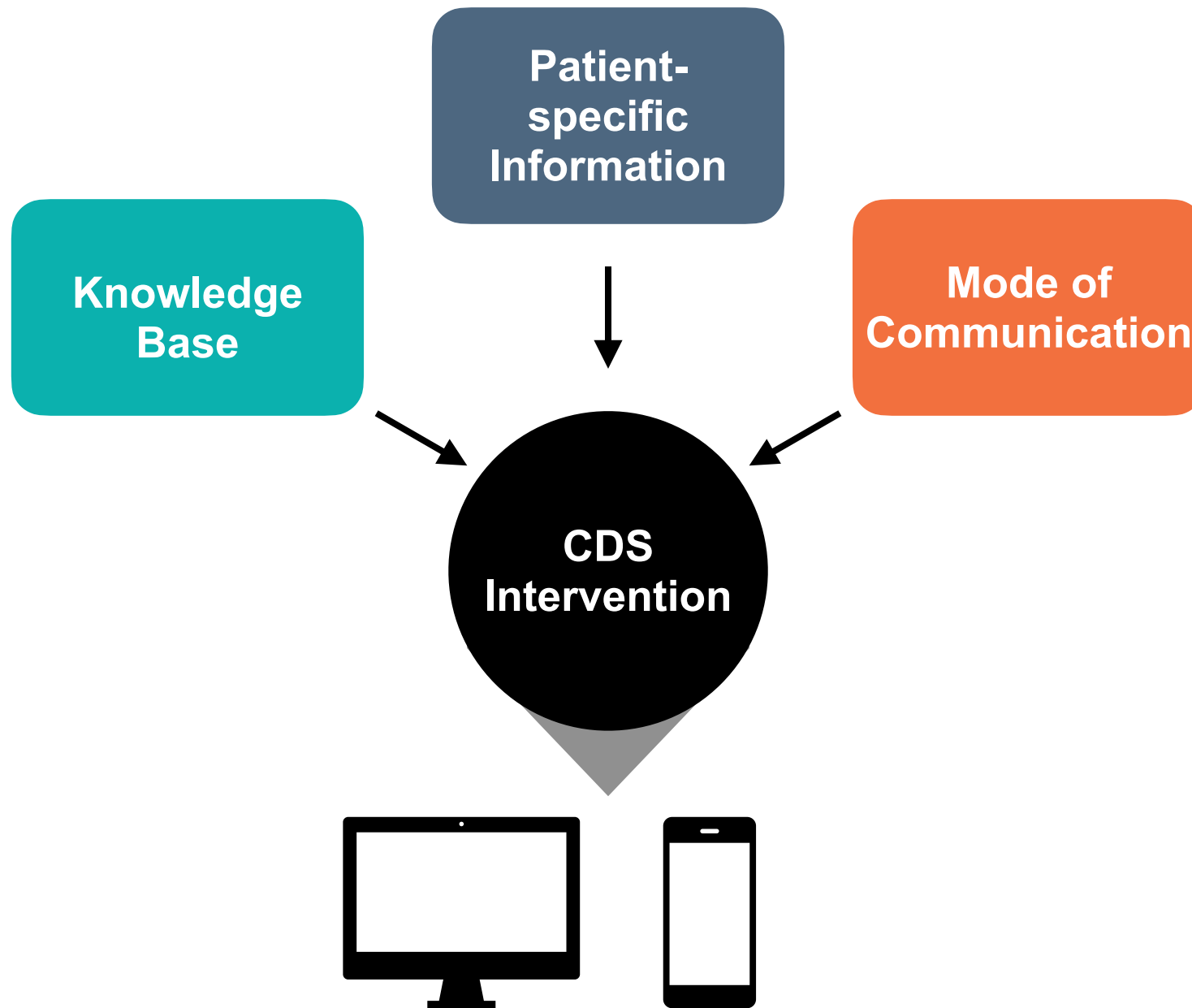
- any electronic tool that reduces the cognitive burden of patient care in an EHR
 - *Order sets & corollary orders*
 - *Data visualization techniques, visual design standards*

Least restrictive:

- “Not all decision support is electronic decision support”

Definitions

- Clinical decision support is any tool that provides clinicians, administrative staff, patients, caregivers, or other members of the care team with information that is filtered or targeted to a specific person or situation. CDS is intended to improve care quality, avoid errors or adverse events, and allow care team members to be more efficient.



Key Functions of CDSS

Function	Example
Alerting	Highlighting out-of-range laboratory values
Reminding	Reminding the clinician to schedule a mammogram
Critiquing	Rejecting an electronic order
Interpreting	Interpreting the echocardiogram
Predicting	Predicting risk of mortality from a severity-of-illness score
Diagnosing	Diagnosing Listing a differential diagnosis for a patient with chest pain
Assisting	Tailoring the antibiotic choices for liver transplantation and renal failure
Suggesting	Generating suggestions for adjusting the mechanical ventilator

*Adapted from:
Randolph AG et al. User's guide to the
medical literature XVIII. JAMA 1999.*

What is good CDSS design?

- Provide measurable value in addressing a recognized problem area or area for improvement
- Leverage multiple data types to bring the most current and relevant evidence and evidence-based practice recommendations to bear on clinical decisions
- Produce actionable insights from the abundant multiple data sources
- Deliver information to the user that allows the user to make final practice decisions, rather than being opaque and acting autonomously
- Demonstrate good usability principles, including clear displays and rapid action options
- Are testable in small settings with a clear path to larger scalability
- Support successful participation in quality and value improvement initiatives.

Adapted from:

Tcheng, J. E., S. Bakken, D. W. Bates, H. Bonner III, T. K. Gandhi, M. Josephs, K. Kawamoto, E. A. Lomotan, E. Mackay, B. Middleton, J. M. Teich, S. Weingarten, and M. Hamilton Lopez, editors. 2017. Optimizing Strategies for Clinical Decision Support: Summary of a Meeting Series. Washington, DC: National Academy of Medicine.

5 Rights of CDSS

Adapted from:

Sirajuddin AM, Osheroff JA, Sittig DF, Chuo J, Velasco F, Collins DA. Implementation pearls from a new guidebook on improving medication use and outcomes with clinical decision support. Effective CDS is essential for addressing healthcare performance improvement imperatives. J Healthc Inf Manag. 2009 Fall;23(4):38-45. PMID: 19894486; PMCID: PMC3316472.

1. Right Information

- quality of knowledge base

2. Right Person

- target of CDS

3. Right Format

- Implementation of CDS (speed, ease of use, comprehensibility)

4. Right Channel

- mode of CDS

5. Right Time

- workflow integration

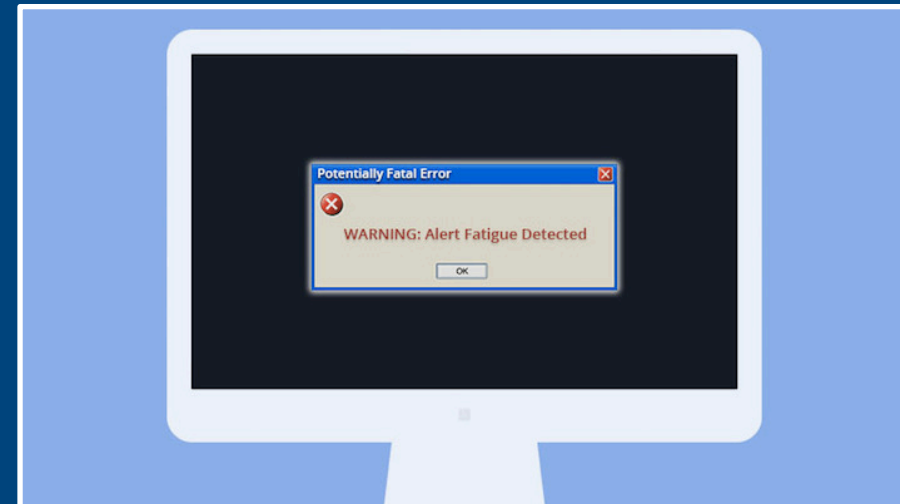
Design Considerations

- **Desired Outcome / Clinical Target**
 - Improve efficiency
 - Earlier detection / screening
 - Diagnosis / Treatment protocol
 - Prevent adverse outcome
 - Follow-up management
 - Cost reductions / convenience
- **Target Audience**
 - Which member of healthcare team?
 - Is intervention targeted to patients / families?
- **Level of Control**
 - Pre-emptive
 - Suppressible
 - Hard-stop
 - Interruptive

Design Considerations

- **Modes of Delivery**

- Templated data-collection (if you define CDS broadly)
- Suggestion (is this the correct diagnosis?)
- Summarization (eg: results review)
- Reminder
- Information
- Correct errors
- Recommend change in plan



10 Commandments of CDSS

Adapted from:

Bates DW, Kuperman GJ, Wang S, Gandhi T, Kittler A, Volk L, Spurr C, Khorasani R, Tanasijevic M, Middleton B. 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. doi: 10.1197/jamia.M1370. Epub 2003 Aug 4. PMID: 12925543; PMCID: PMC264429.

- 1. Speed is everything**
 - expect sub-second latency
- 2. Anticipate needs and deliver in real time**
 - showing relevant labs with med orders
- 3. Fit into the user's workflow**
 - external tools not as good as those at POC
- 4. Little things can make a big difference**
 - “usability matters – a lot”, “make it easy to do the right thing”
- 5. Physicians resist stopping**
 - don't tell docs to not do something without offering an alternative

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PMID: 12925543; PMCID: PMC264429.*

6. Changing direction is easier than stopping

7. Simple interventions work best

- try to fit guidelines onto a single screen

8. Ask for additional information only when you really need it

- “likelihood of success is inversely proportional to the number of extra data elements needed”

9. Monitor impact, get feedback, and respond

10. Manage and maintain your knowledge based systems

Specific Categories of CDSS (Leapfrog)

Categories of CDSS	
Therapeutic duplication	Cost of care
Single & cumulative dose limits	Nuisance
Allergies & cross allergies	Contraindications / dose limits based on patient diagnosis
Contraindicated route of administration	Contraindications / dose limits based on patient age or weight
Drug-drug and drug-food interactions	Contraindications / dose limits based on laboratory studies
Corollary orders	Contraindications / dose limits based on radiology studies (eg: recent or ordered IV)

Use of CDSS in Armenia

Discussion

Discussion & Examples

Thank You



Please, give me feedback:

<https://tinyurl.com/JuanEval>

<https://airtable.com/shrgBH0ltwKdyyjDW>

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