Implicit and Explicit Cognition in Crossing the Consciousness Divide

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IDEAS
VA Salt Lake Informatics, Decision-Enhancement And Analytic Sciences Center

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VA HEALTH CARE Defining EXCELLENCE in the 21st Century

Theory and Innovation in Cognitive Support for Health Care Decision-Making

VA Salt Lake City Informatics, Decision-Enhancement, and Analytic Sciences (IDEAS) Center

Introduction

"Modeling the Mind: How do we design effective decision-support?"

Concern with EHR Design

- Discontent and dissatisfaction with EHRs is ubiquitous
  - Burn-out
  - Frustration
  - Added time
  - Confusion
  - Patient safety concerns
- Standard approaches to decision support have had mixed impact

Theory-Inspired Design

Dual Process Theory of Thinking

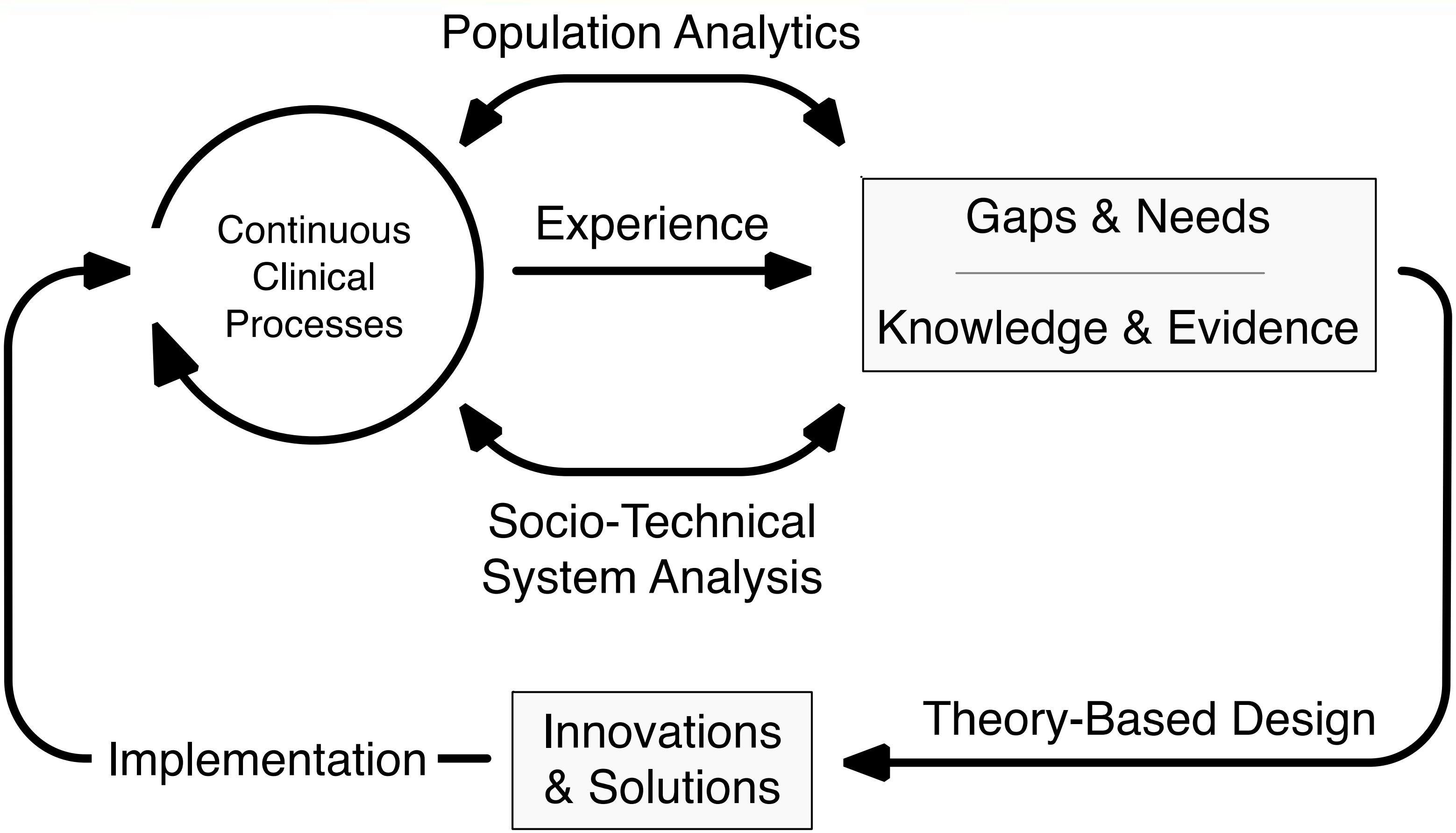
System 1
- Fast
- Unconscious
- Implicit
- Automatic
- Holistic
- Impulsive

System 2
- Slow
- Conscious
- Explicit
- Controlled
- Analytic
- Reflective

Integrated Model of Design

1. Support for Pattern Matching
2. Highlight the Motivational Components
3. Tools to Support Control of Information Space

Theory-Inspired Design



Conceptual Framework for IDEAS Research

Journal of Biomedical Informatics Supplement Articles

1. Modeling the mind: How do we design effective decision-support? (Editorial)
2. Checking the lists: A systematic review of electronic checklist use in health care (Review)
3. Identifying complexity in infectious diseases inpatient settings: An observation study
4. Think twice: A cognitive perspective of an antibiotic timeout intervention to improve antibiotic use
5. Making cognitive decision support work: Facilitating adoption, knowledge and behavior change through QI
6. Detecting the presence of an indwelling urinary catheter and urinary symptoms in hospitalized patients using natural language processing
7. Veterans Like Me: Formative evaluation of a patient decision aid design
8. Physicians' perception of alternative displays of clinical research evidence for clinical decision support – A study with case vignettes
9. Translation of Contextual Control Model to chronic disease management: A paradigm to guide design of cognitive support systems
10. A pilot study of a heuristic algorithm for novel template identification from VA electronic medical record text

Cyber Seminar Series

- Session 1:

"Implicit and Explicit Cognition in Crossing the Consciousness Divide"

Cyber Seminar Series

- Session 2:

"Integrating Dual Process Implications into Implementation of Cognitive Support Designs in the Clinical Setting"

August 23, 2017 - **2:00PM** ET

- Session 3:

"Integrating Pattern Matching and Active Thinking Support in Information Displays for Clinicians"

August 30, 2017 - **12:00PM** ET

Session 1: Articles

- Think twice: A cognitive perspective of an antibiotic timeout intervention to improve antibiotic use
  - Makoto Jones, MD, MS; Jorie Butler, PhD; Christopher J Graber, MD, MPH; Peter Glassman, MBBS, MSc; Matthew H Samore, MD; Lori A Pollack, MD, MPH; Charlene Weir, PhD, RN; Matthew B Goetz, MD

- Identifying complexity in infectious diseases inpatient settings: An observation study
  - Don Roosan, PharmD, PhD; Charlene Weir, PhD, RN; Matthew H Samore, MD; Makoto Jones, MD, MS; Mumtahena Rahman, PhD, PharmD; Gregory J Stoddard, MS; Guilherme Del Fiol, MD, PhD

JBI Supplement Link

http://www.sciencedirect.com/science/journal/15320464/71/supp/S

Makoto Jones, Jorie Butler, Christopher Graber, Peter Glassman, Lori Pollack, Charlene Weir, Matthew Goetz

THINK TWICE: A COGNITIVE PERSPECTIVE OF AN ANTIBIOTIC TIMEOUT INTERVENTION TO IMPROVE ANTIBIOTIC USE

J Biomed Inform. 2016 Jun 18. pii: S1532-0464(16)30048-X. doi: 10.1016/j.jbi.2016.06.005.

Disclosures and disclaimers

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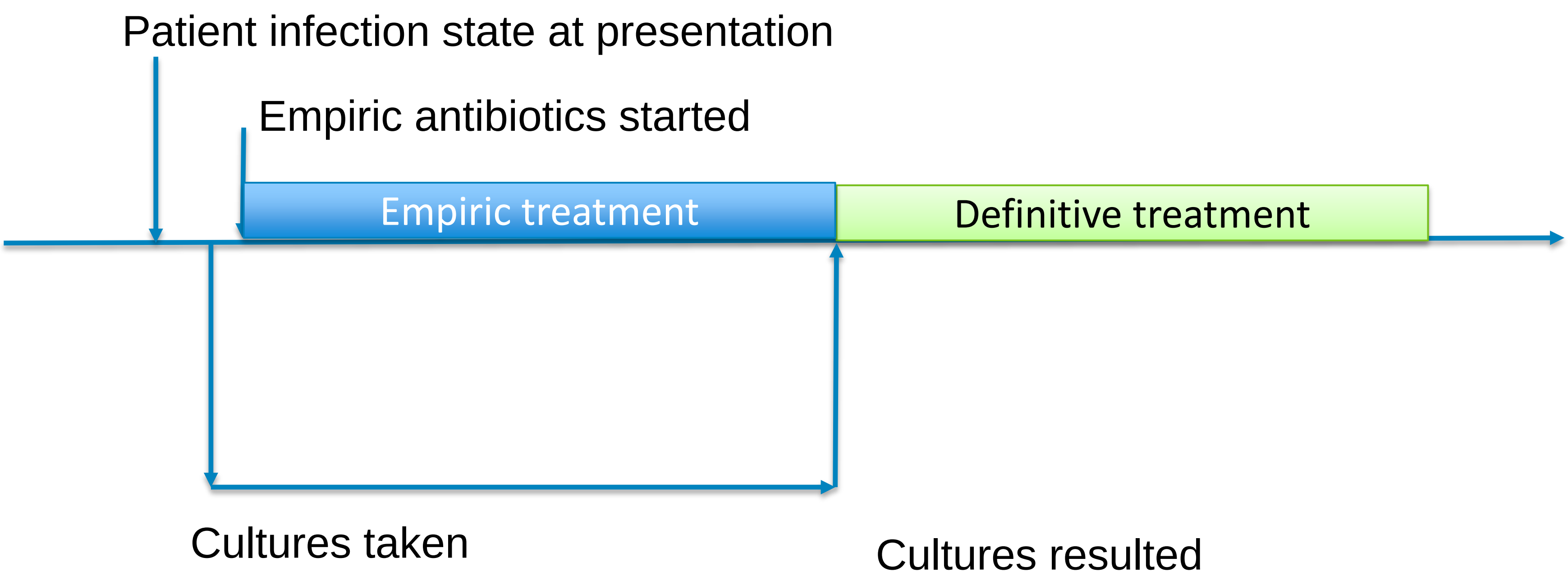
- The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the US Department of Veterans Affairs

For those that have ever prescribed antibiotics, how much effort did you put into the decision on average?

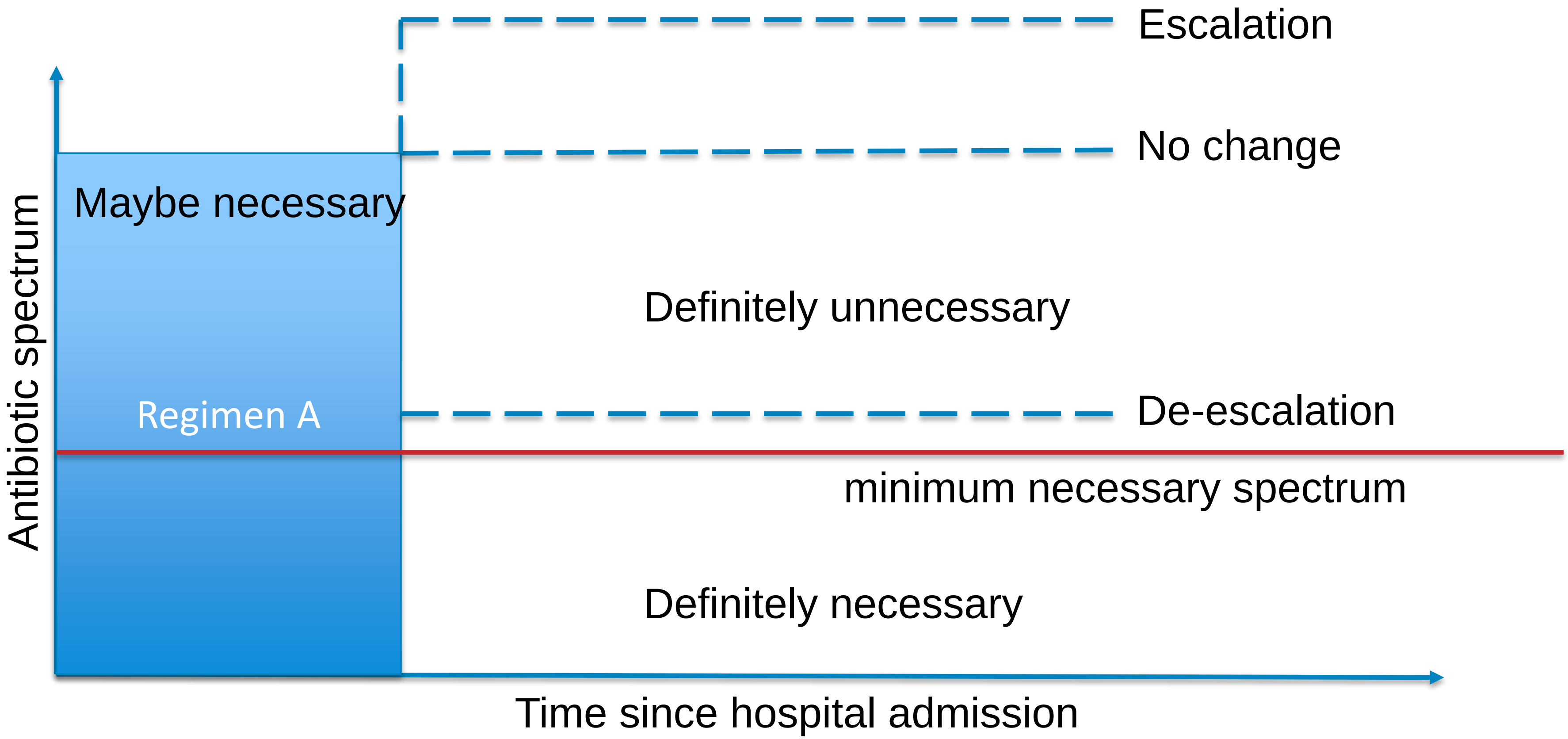
A. All I need is a pen and a prescription pad!
B. I spend 2 minutes thinking about it or discussing it with the team.
C. I spend 10 minutes thinking about it or discussing it with the team.
D. I am paralyzed by all of the things to consider.

E. I usually ask for help
F. I don’t prescribe antibiotics

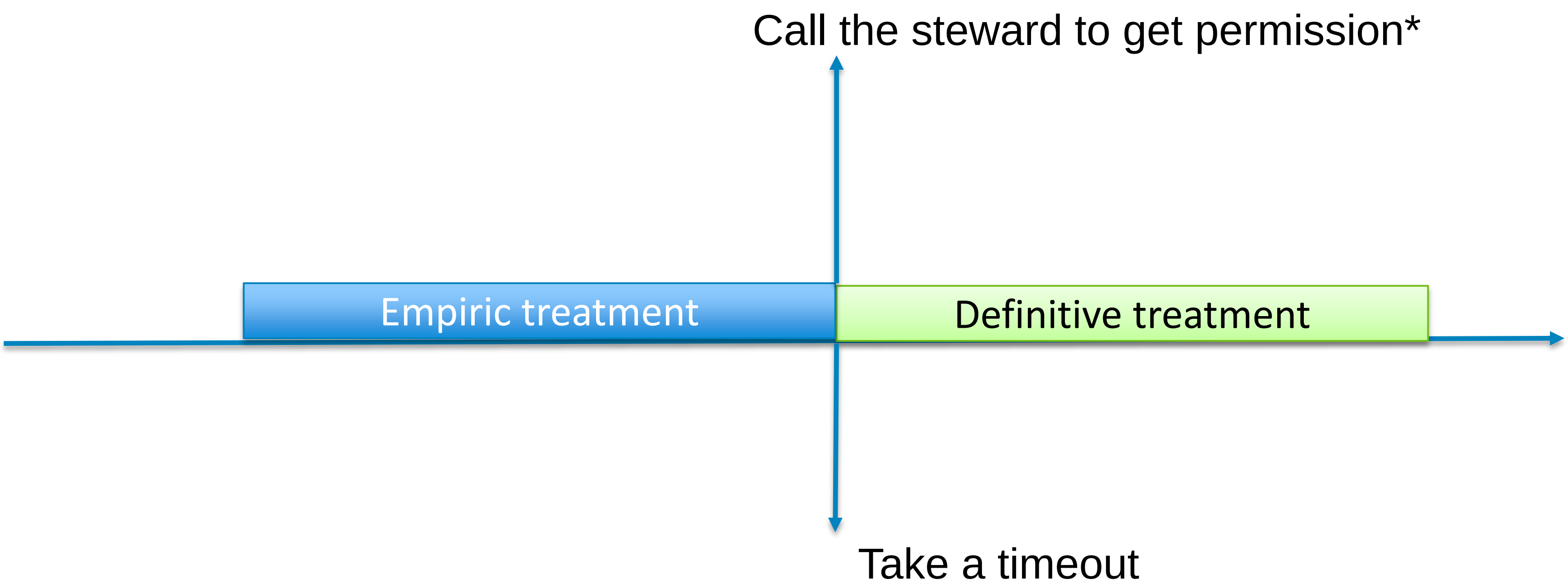
Information lags can force us to treat diseases that patients do not have



De-escalation simplified



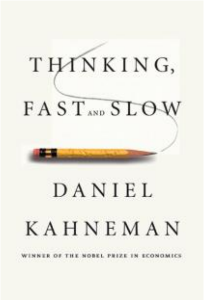
Timeout



*page, track down, then wait while they look things up…

Dual process theory

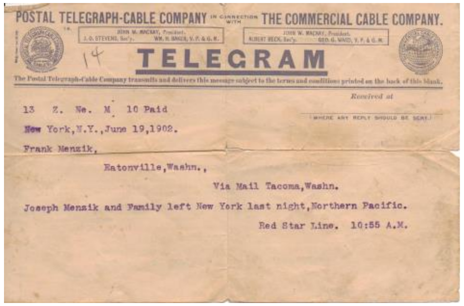
Sensory input



x100s/sec

System 1
* automatic

System 2
* effortful



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TELEGRAM

The Postal Telegraph-Cable Company transmits and delivers this message subject to the terms and conditions printed on the back of this blank.

Received at

(WHERE ANY REPLY SHOULD BE SENT.)

13 Z. Ne. M 10 Paid

New York, N.Y., June 19,1902.

Frank Menzik,

Eatonville, Washn.,

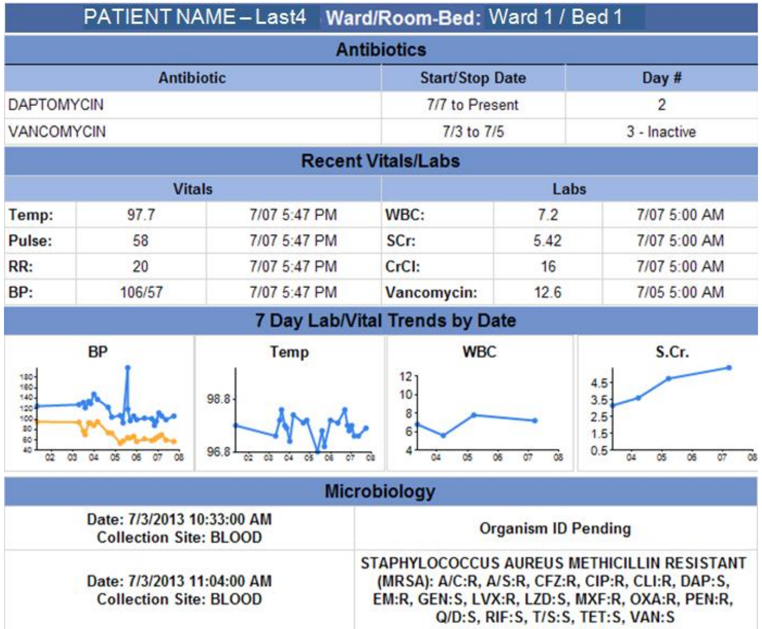
Via Mail Tacoma, Washn.

Joseph Menzik and Family left New York last night, Northern Pacific.

Red Star Line. 10:55 A.M.

Antimicrobial Timeout at VA GLA HCS

- Distributed hardcopy to teams that have potential "time out" patient
- Housestaff could request access to the dashboards
- "One-stop" visual aid having relevant microbiological, clinical and antibiotic data
- Attestation of the timeout



PATIENT NAME – Last4 **Ward/Room-Bed:** Ward 1 / Bed 1

Antibiotics

Antibiotic	Start/Stop Date	Day #
DAPTOMYCIN	7/7 to Present	2
VANCOMYCIN	7/3 to 7/5	3 - Inactive

Recent Vitals/Labs

Vitals			Labs		
Temp:	97.7	7/07 5:47 PM	WBC:	7.2	7/07 5:00 AM
Pulse:	58	7/07 5:47 PM	SCr:	5.42	7/07 5:00 AM
RR:	20	7/07 5:47 PM	CrCl:	16	7/07 5:00 AM
BP:	106/57	7/07 5:47 PM	Vancomycin:	12.6	7/05 5:00 AM

7 Day Lab/Vital Trends by Date

Microbiology

Date: 7/3/2013 10:33:00 AM Collection Site: BLOOD	Organism ID Pending
Date: 7/3/2013 11:04:00 AM Collection Site: BLOOD	STAPHYLOCOCCUS AUREUS METHICILLIN RESISTANT (MRSA): A/C:R, A/S:R, CFZ:R, CIP:R, CLI:R, DAP:S, EM:R, GEN:S, LVX:R, LZD:S, MXF:R, OXA:R, PEN:R, Q/D:S, RIF:S, T/S:S, TET:S, VAN:S

Piperacillin/Tazobactam template

This template is intended promote a "Time Out" to reconsider the need for reordering vancomycin. Continued therapy will be approved if the template is properly completed.

…

Is a bacterial infection present?

Definitely no/very unlikely | Possibly | Definitely yes/very likely

Focus Groups

- 6 focus groups
  - Held 2 weeks after intervention implementation
  - Users or potential users in internal medicine and ICU; pharmacy
  - Audiotaped and transcribed
- Analysis
  - Atlas@ti
  - Multiple reviewers, 40h discussion
  - Initial precodes iteratively refined
  - Defined and coded ultimate categories

Stop and think

Themes	Description
Captures and controls attention	*"…as a resident you try to… avoid unnecessary use of antibiotics regardless, so … **it reminds us to think** about it…"*
Enhances informed and deliberative reasoning	*"It makes you **think twice.**"*
Redirects decision direction by making inappropriate vancomycin and piperacillin/tazobactam discontinuation easier than continuation	*"**No, seriously, the fact that they handed me this form in the morning saying, oh, we're tracking your vanco usage made me not want to use it**."*
Fosters autonomy and improves team empowerment	*"I think the template is good in that **it forces the team to really discuss** it."*
Limits use of emotion-based heuristics.	*Clinician 1: "And when we speak to the pharmacist as well, if they're saying, well, I don't see why you're choosing this antibiotic; why don't you just choose this? We can say to them person to person, look, my concern…**my clinical concern is high enough** I think they need more aggressive therapy at least for right now and usually they will agree to that because it's clinical judgment…" Clinician 2: "… You can say that about everybody and put everybody on vancomycin…"*

http://dx.doi.org/10.1016/j.jbi.2016.06.005

Appropriateness before and after intervention

Table 2. Review of appropriateness of antibiotic continuation

	Before time-out	Time-out	*P*
Vancomycin			
Antibiotic courses eligible for renewal	199	145	
Inappropriate continuations	0 (0%)	7 (5%)	.002
Courses discontinued (through day 5)	96 (48%)	93 (64%)	.004
Piperacillin-tazobactam			
Antibiotic courses eligible for renewal	93	105	
Inappropriate continuations	2 (2%)	9 (9%)	.06
Courses discontinued (through day 5)	58 (62%)	70 (67%)	.55

"I find the dashboard useful in decision making" was highly correlated with intent to use the dashboard ($R_2 = 0.79$, $P < .01$)

Graber et al, Hospital Pharmacy Vol 50, Issue 11, pp. 1011 - 1024

Total Antibiotic Use Before & After Timeout: Trend Analysis

All use* Per 1,000 pt-days	Implementation Period Pre-	Post-	% change[#] (95%CI), p
Vancomycin	102.7	76.4	-13% (-22%, -4%), 0.01
Piperacillin/tazo	52.6	49.3	0.2% (-13%, 16%), 0.98

- Days of therapy with vancomycin or piperacillin per 1,000 days among ALL hospitalized patients in primary intervention areas

[#] Adjusted for time since the intervention

The use of non-vancomycin, anti-MRSA antibiotics showed a non-significant decrease during the study period

Remember to Think Twice

- Many thanks to the other co-authors
- The many participants in VA Greater Los Angeles Health Care System
- VA Health Services Research and Development
- VA National Infectious Diseases Service
- VA Pharmacy Benefits Management
- VA Office of Informatics and Analytics
- VA Office of Information Technology

Mini-Series on Informatics and Effective Decision Support

Don Roosan, PharmD, PhD

VA SLC HSR&D Center for Innovation

August 16, 2017

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VA HEALTH CARE Defining EXCELLENCE in the 21st Century

Objectives

- Discuss task and patient complexity
- Learn opportunities for identifying complexity
- Explain implications of identifying complexity for HIT system design
- Understand the importance of task complexity for comprehension of overall complexity

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Identifying complexity in infectious diseases inpatient settings: An observation study

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ABSTRACT

Background: Understanding complexity in healthcare has the potential to reduce decision and treatment uncertainty. Therefore, identifying both patient and task complexity may offer better task allocation and design recommendation for next-generation health information technology system design.
Objective: To identify specific complexity-contributing factors in the infectious disease domain and the relationship with the complexity perceived by clinicians.
Method: We observed and audio recorded clinical rounds of three infectious disease teams. Thirty cases were observed for a period of four consecutive days. Transcripts were coded based on clinical complexity-contributing factors from the clinical complexity model. Ratings of complexity on day 1 for each case were collected. We then used statistical methods to identify complexity-contributing factors in relationship to perceived complexity of clinicians.
Results: A factor analysis (principal component extraction with varimax rotation) of specific items revealed three factors (eigenvalues > 2.0) explaining 47% of total variance, namely task interaction and goals (10 items, 26%, Cronbach's Alpha = 0.87), urgency and acuity (6 items, 11%, Cronbach's Alpha = 0.67), and psychosocial behavior (4 items, 10%, Cronbach's alpha = 0.55). A linear regression analysis showed no statistically significant association between complexity perceived by the physicians and objective complexity, which was measured from coded transcripts by three clinicians (Multiple R-squared = 0.13, p = 0.61). There were no physician effects on the rating of perceived complexity.
Conclusion: Task complexity contributes significantly to overall complexity in the infectious diseases domain. The different complexity-contributing factors found in this study can guide health information technology system designers and researchers for intuitive design. Thus, decision support tools can help reduce the specific complexity-contributing factors. Future studies aimed at understanding clinical domain-specific complexity-contributing factors can ultimately improve task allocation and design for intuitive clinical reasoning.

Roosan, D., Weir, C., Samore, M., Jones, M., Rahman, M., Stoddard, G. J., & Del Fiol, G. (2016). Identifying complexity in infectious diseases inpatient settings: An observation study. *Journal of biomedical informatics*.

Poll Question

1. Have you heard about task complexity before?

a. Yes, but not in medicine
b. Yes in medicine
c. Never
d. Maybe

Background

- Complexity refers to the amount of information needed to describe a phenomenon

- Previous studies tried to capture complexity by using case-mix measures, biophysical and behavioral dimensions, risk assessments and assigning value on different patient attributes and so on

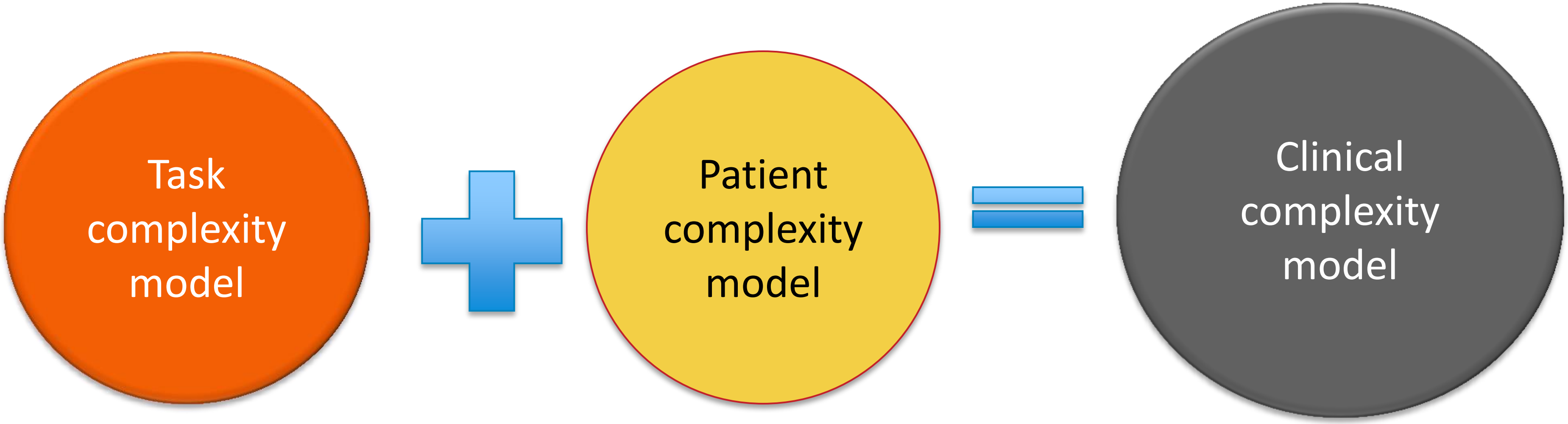
- Task complexity Vs Patient complexity
- Subjective/ Perceived task complexity Vs Objective task complexity
- Infectious Diseases domain is full of complexity

Objective

- Our main goal was to understand the psychological processes of ID physicians coping with complexity

1. We operationalized a clinical complexity measurement model to identify patient and task complexity factors objectively
2. We used perceived complexity constituents to quantify subjective/perceived complexity and compare with our findings of objective complexity

Clinical complexity model



CLINICAL COMPLEXITY IN MEDICINE: A MEASUREMENT MODEL OF TASK AND PATIENT COMPLEXITY IN THE INFECTIOUS DISEASES DOMAIN., R. Islam, C. Weir, G. Del Fiol., *Methods of Information in Medicine*

Task complexity factors

Unnecessary Information
Large number of goals
Large number of decision steps
Multiple decision making options
Lack of expertise
Unclear goals
Confusing information
Conflicting goals
Decision conflict
Lack of team coordination
Urgent information
Changing information
Time pressure

Patient complexity factors

Polypharmacy
Significant physical illness
Mental anxiety
Psychological illness
Addictions/substance abuse
Older age
Health disparity
Noncompliant patient
Poverty and low social support
Heavy utilization of healthcare resources
Difficulty with healthcare system navigation

Clinical complexity-contributing factors(CCFs)

Task complexity factors

Multiple decision-making options	**Large number of options to make a decision**
Large number of decision steps	More than two steps or actions to attain the objective

Patient complexity factors

Poly pharmacy	**Patient receiving medications from more than one pharmacy**
Significant physical illness	**Multiple chronic conditions, loss of physical functioning**

Methods

- *Settings and Participants*
  - Observed rounds of 3 ID team in University of Utah and VA Salt lake City Hospital
  - IRB approved
  - Each team consisted , one ID physician, one ID fellow, one PA, one ID resident
- *Description of procedures*
  - ✓ Observed 30 cases over 4 days
  - ✓ Inclusion criteria included referral of ID team by the primary care team
  - ✓ Rounds were audio recorded and transcribed
  - ✓ After round on day 1, ID experts were asked to rate the case based on criteria of perceived complexity

Methods: Perceived complexity

Criteria	Questions
Diagnostic Uncertainty	How uncertain are you about the diagnosis of this patient? (1=very certain; 7=very uncertain).
Perceived Difficulty	How difficult does this case seem to you? (1=not difficult; 7=very difficult).
Treatment Unpredictability	How confident are you about the treatment outcome? (1=very predictable; 7=very unpredictable).
Case Similarity	How similar is this patient compared with your previous patients? (1=very similar 7=very unique)

Liu P, Li Z. Task complexity: A review and conceptualization framework. International Journal of Industrial Ergonomics. 2012;42(6):553-68.

Methods

- Total of 252 pages of transcripts were coded
- Coding the transcript was iterative
  - ✓ Three researcher with clinical background
  - ✓ Group consensus after each iteration
  - ✓ Final inter-rater reliability (Cohen's kappa) was 0.8

<u>Statistical analysis on coding frequencies:</u>

- One-way ANOVA
- Levene's homogeneity of variance test
- Cronbach's alpha
- Principal component analysis
- Regression analysis

Results

- Physician effect
  - No significant difference in means of perceived complexity scores among three physicians (means were 3.6, 3.2, 4.0; p-0.33)
  - No significant difference between three physicians (Standard deviations of three physicians score 1.2,1.2,1.4; p=0.94)
- Internal consistency of Perceived complexity
  - Ratings ranged from 6 to 26 (average 14.3; SD=5.11)
  - Cronbach's alpha 0.76
- Factor analysis revealed three factors for objective complexity
  - Task interactions and goals, Urgency and acuity and Psychosocial behaviors

Results

- Relationship between objective and perceived complexity
  - Not significant (Multiple R-squared=0.13, p=0.61)

Complexity factors	Proportion of variance explained
Task interactions and goals	26%
Urgency and acuity	11%
Psychosocial behaviors	10%

Results: Task interaction and goals

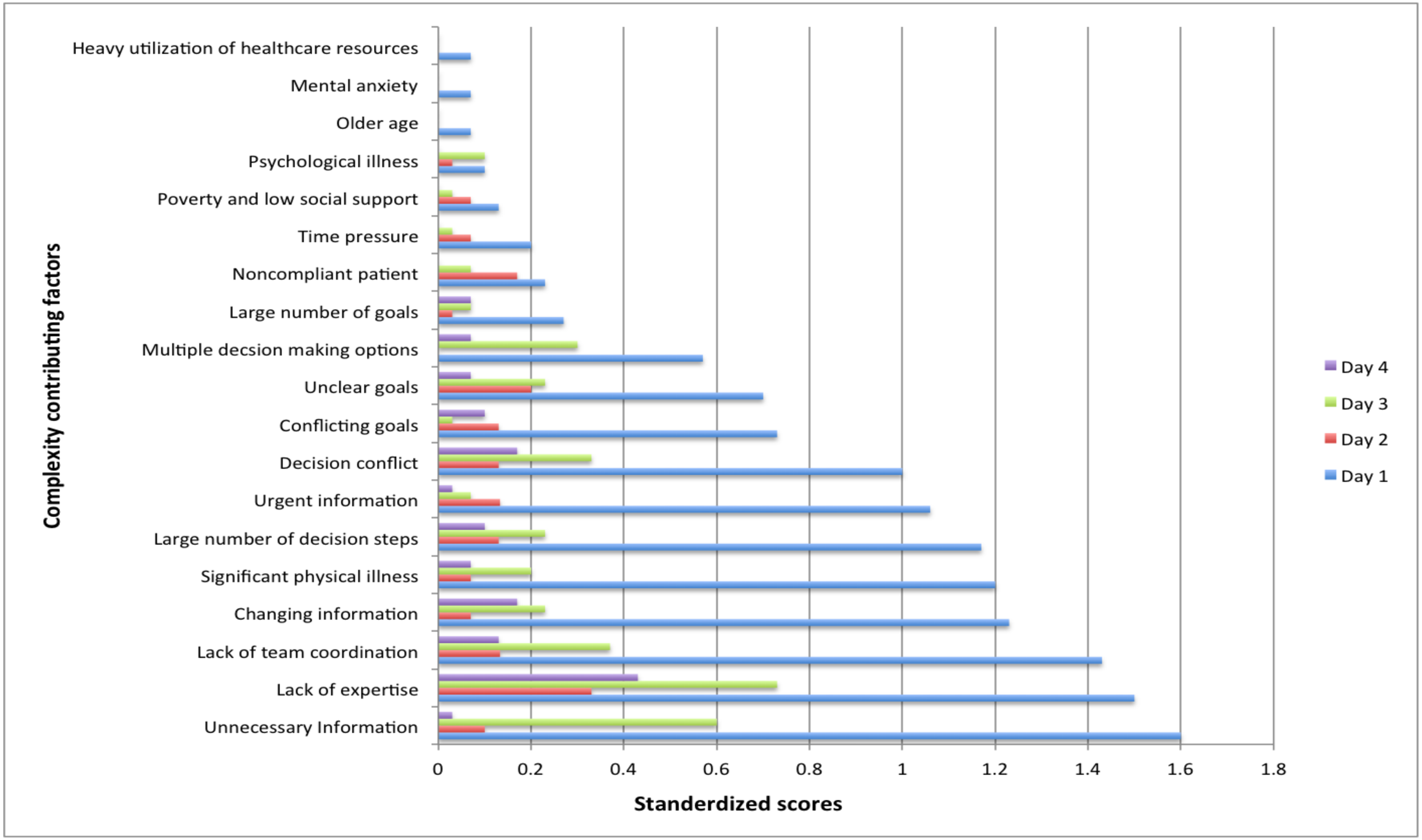
Confusing information
Decision conflict
Lack of team coordination
Multiple decision making options
Lack of expertise
Unnecessary information
Conflicting goals
Unclear goals
Large number of goals
Large number of decision steps

Results

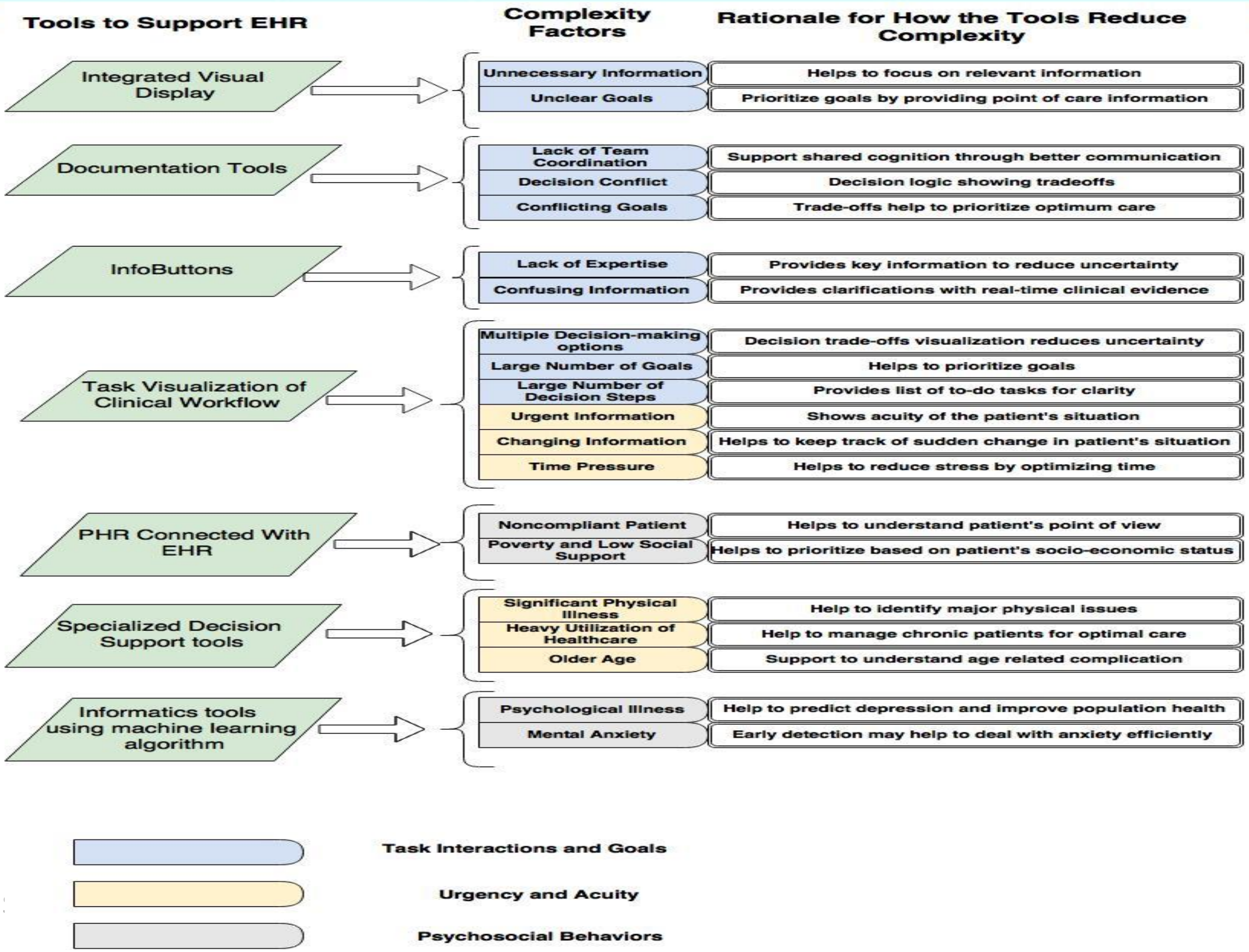
Psychosocial behaviors
Urgent information
Older age
Heavy utilization of healthcare
Changing information
Significant physical illness
Time pressure

Urgency and acuity
Non-compliant patient
Psychological illness
Mental anxiety
Poverty and low social support

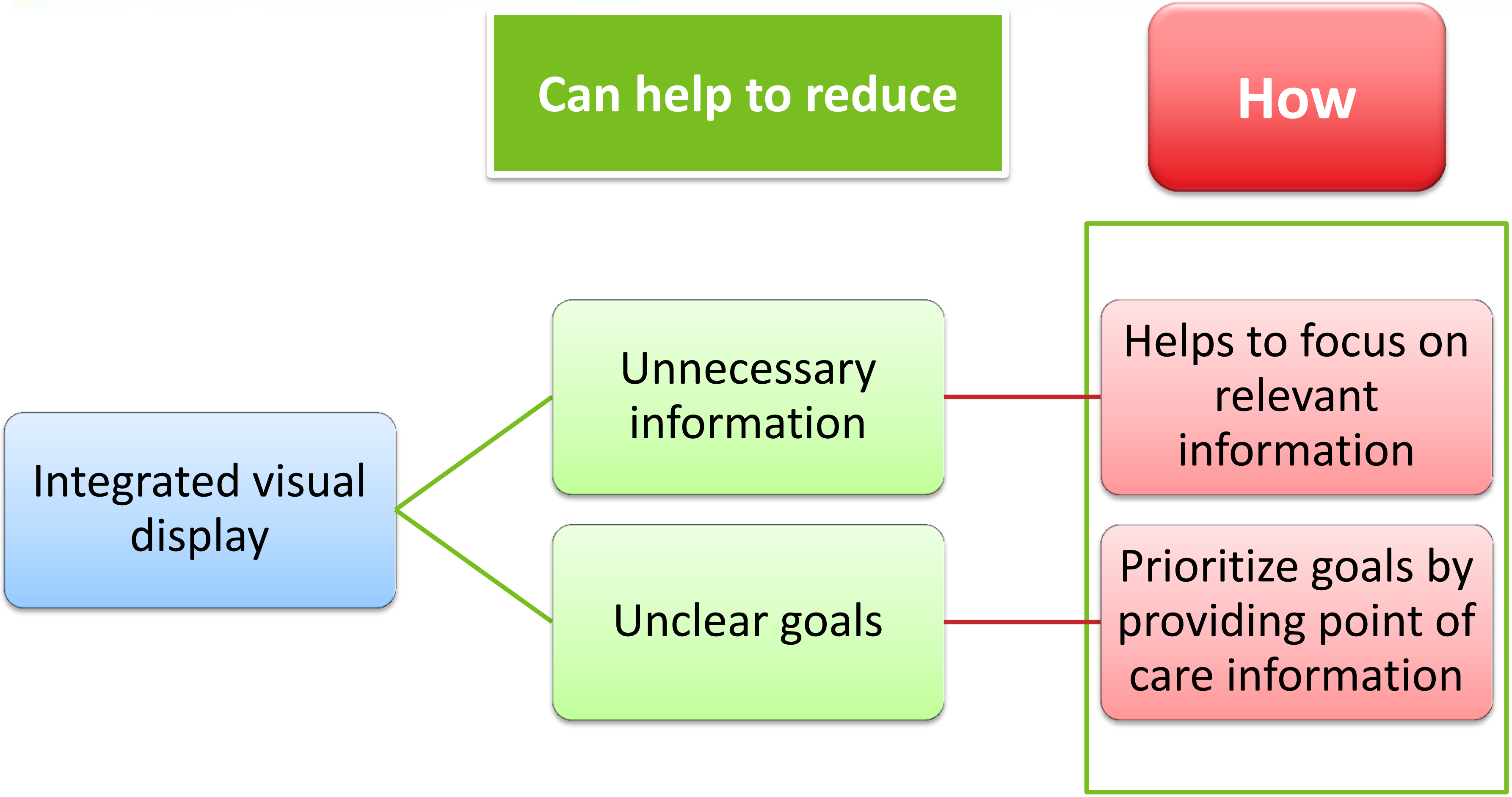
Results: complexity with changing days



Discussion


Tools to Support EHR
Complexity Factors
Rationale for How the Tools Reduce Complexity
Integrated Visual Display
Unnecessary Information
Helps to focus on relevant information
Unclear Goals
Prioritize goals by providing point of care information
Documentation Tools
Lack of Team Coordination
Support shared cognition through better communication
Decision Conflict
Decision logic showing tradeoffs
Conflicting Goals
Trade-offs help to prioritize optimum care
InfoButtons
Lack of Expertise
Provides key information to reduce uncertainty
Confusing Information
Provides clarifications with real-time clinical evidence
Task Visualization of Clinical Workflow
Multiple Decision-making options
Decision trade-offs visualization reduces uncertainty
Large Number of Goals
Helps to prioritize goals
Large Number of Decision Steps
Provides list of to-do tasks for clarity
Urgent Information
Shows acuity of the patient's situation
Changing Information
Helps to keep track of sudden change in patient's situation
Time Pressure
Helps to reduce stress by optimizing time
PHR Connected With EHR
Noncompliant Patient
Helps to understand patient's point of view
Poverty and Low Social Support
Helps to prioritize based on patient's socio-economic status
Specialized Decision Support tools
Significant Physical Illness
Help to identify major physical issues
Heavy Utilization of Healthcare
Help to manage chronic patients for optimal care
Older Age
Support to understand age related complication
Informatics tools using machine learning algorithm
Psychological Illness
Help to predict depression and improve population health
Mental Anxiety
Early detection may help to deal with anxiety efficiently
Task Interactions and Goals
Urgency and Acuity
Psychosocial Behaviors

Discussion: Mapping of CCFs (example)



Limitations

- Other sources of complexity were not included
  - Patient-provider interaction
  - Provider-provider interaction
  - Care transition
- The cause of discrepancies between clinician's perceived complexity and objective complexity was not further investigated
- Generalizability may be an issue

Conclusion

Task complexity is very prominent in understanding overall complexity

Identifying domain specific complexity contributing factors may help with domain specific design

More research needed to understand task complexity in other domain of medicine as well

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