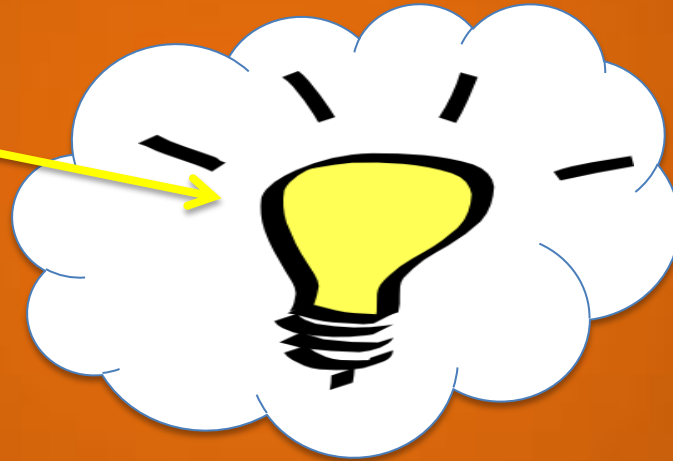
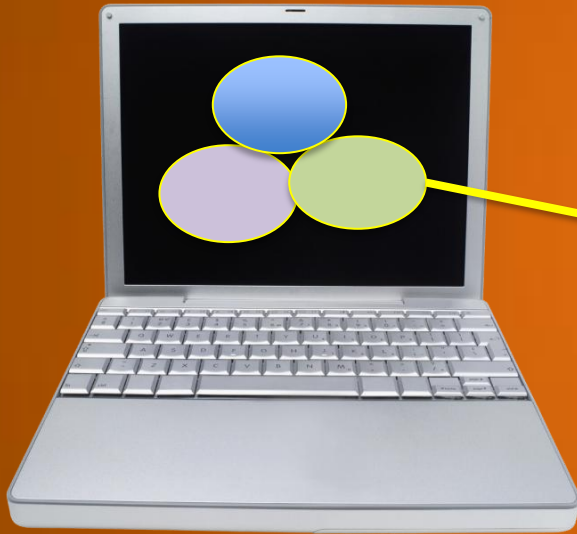


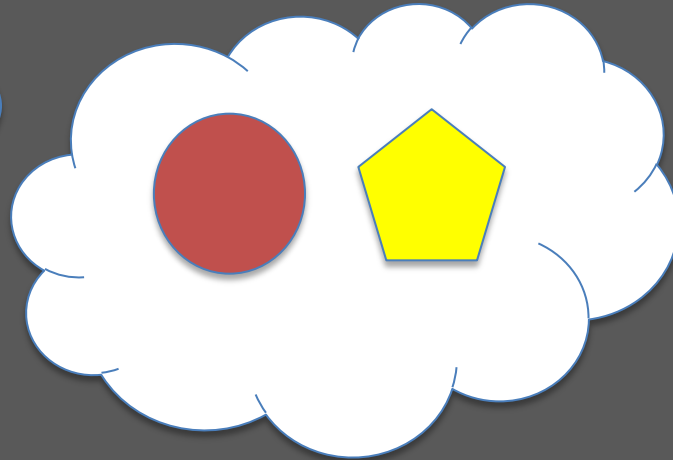
Cognitive Support for Clinical Comprehension



Trevor Cohen, MBChB, PhD

Distributed Cognition: HCI Implications

- Human-machine system with greater capacity than its component parts
 - Hutchins (1995), Norman (1993)



HIT Implications : Division of Labor

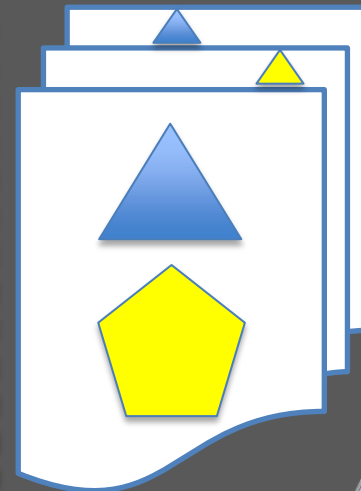
- Finite attention
- Limited time

SYNTHESIS

AGGREGATION

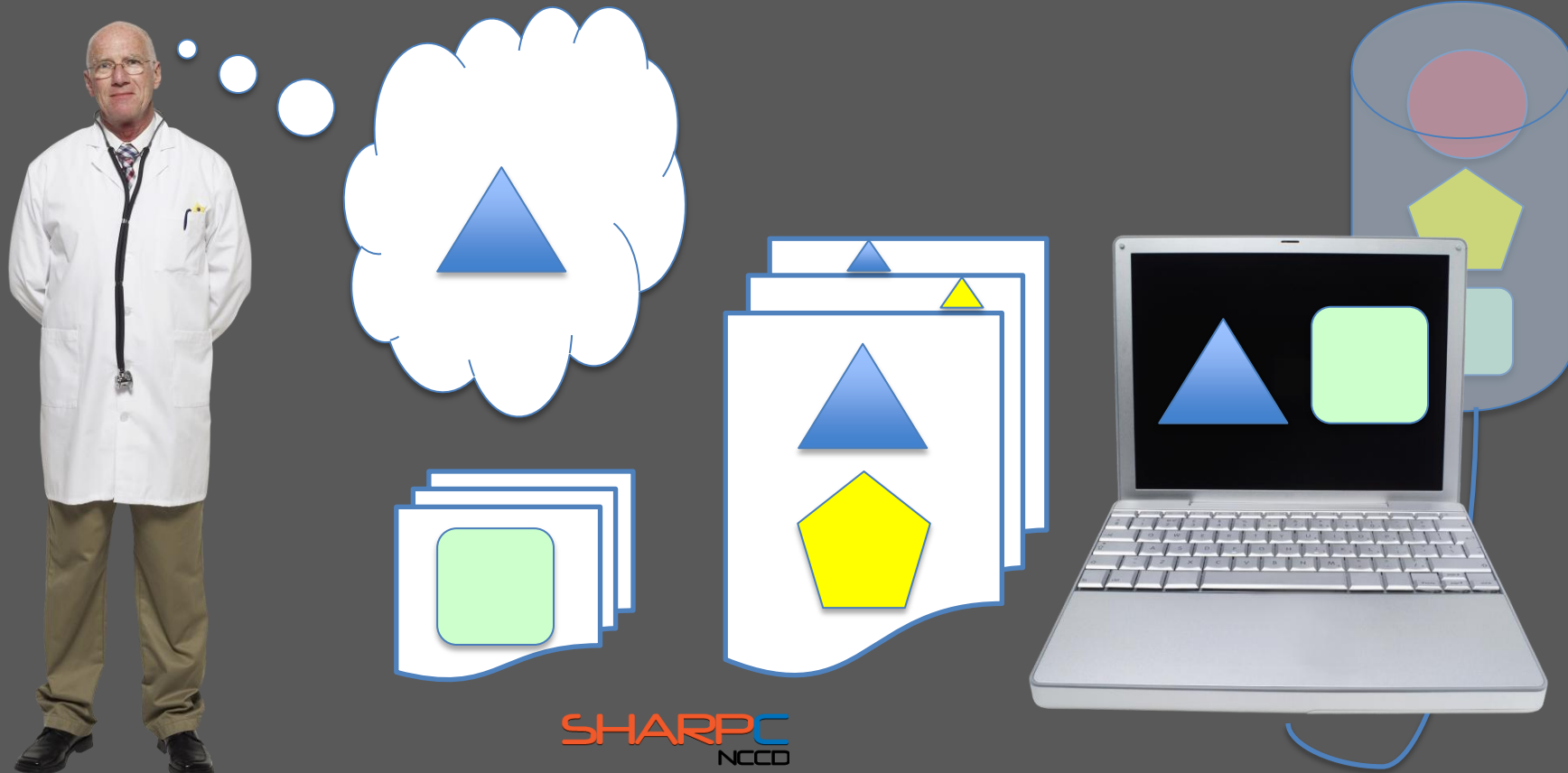
SEARCH

- Redundantly represented
- Temporally organized
- Frequently ignored
(Hripcsak *et al* 2011)



Distributed Cognition

- Human-machine system with greater storage capacity than its component parts



Division of Labor

PROBLEM SOLVING

COMPREHENSION

SYNTHESIS

AGGREGATION

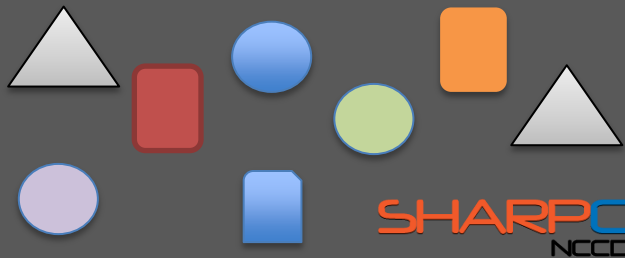
SEARCH

STORAGE / RETRIEVAL



Clinical Comprehension : A Prerequisite to Problem Solving

- Patel *et al* 1994



Observations

Meaningful Clusters

- Patel *et al* 1994

Diagnosis

Clusters of findings
(intermediate constructs)

Observations

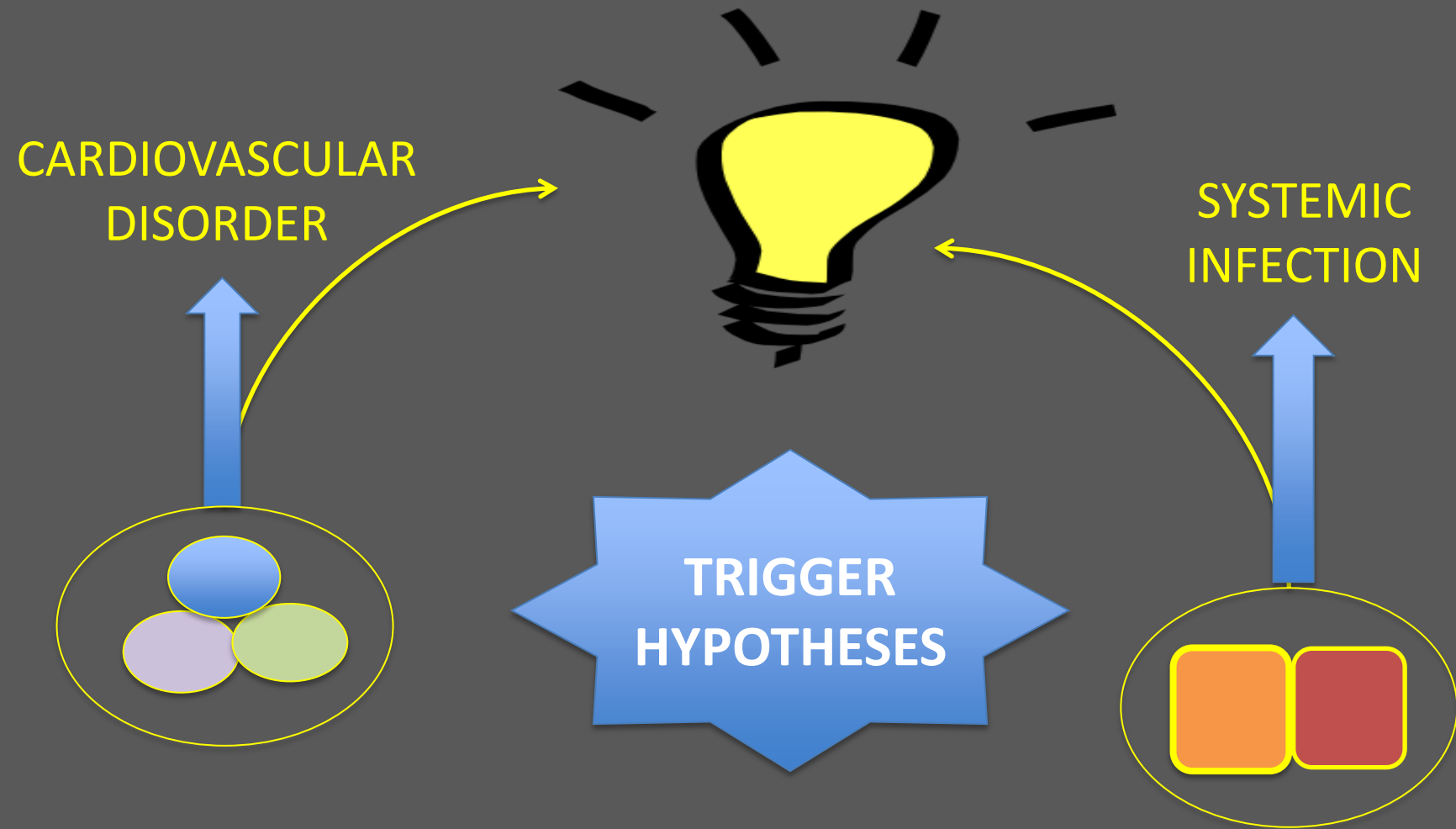


Perception and Expertise

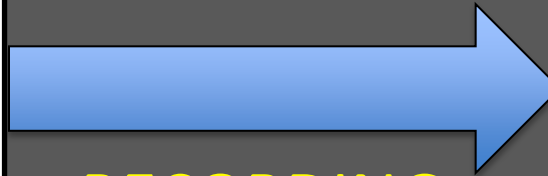
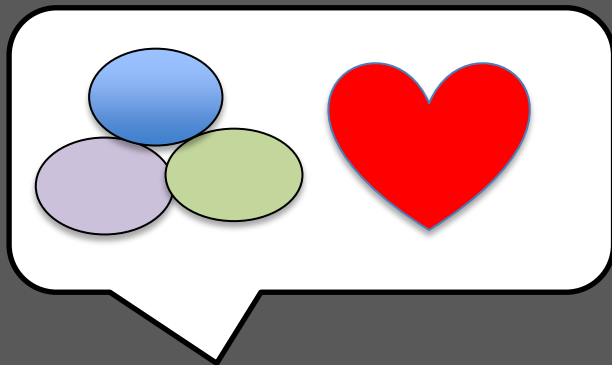
- Recognize and remember meaningful patterns
 - DeGroot (1965)
 - Chase and Simon (1973)
- Represent problems in a deeper, more principled manner
 - Physics: Chi Feltovich and Glaser (1991)



Purposeful Clusters

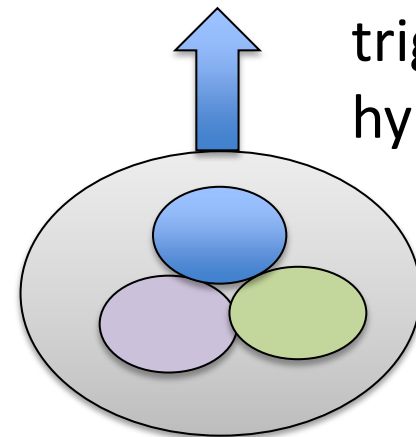


Capturing Clusters: Human-intensive Methods



RECORDING
TRANSCRIPTION
ANALYSIS

CARDIOVASCULAR
DISORDER



trigger
hypothesis

FINITE NUMBER
OF COGNITIVE
OPERATIONS

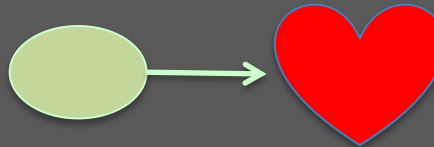


Capturing Clusters: Computer-aided Knowledge Elicitation

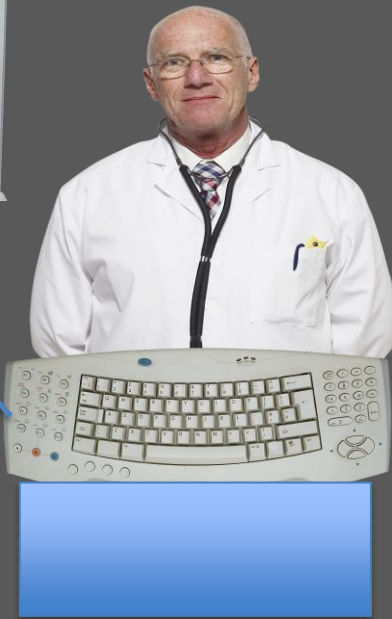
DEIDENTIFIED
CLINICAL DATA



SUBSET OF
RELATIONSHIP
TYPES



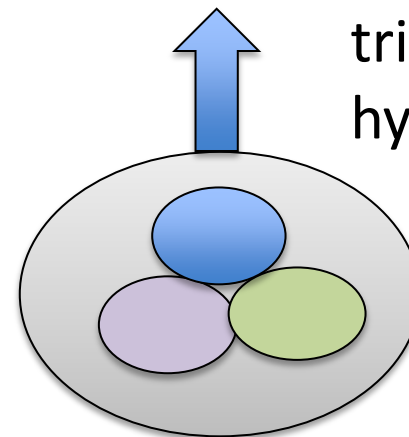
LESS GRANULAR
MORE VOLUME



ANNOTATION
TOOL



CARDIOVASCULAR
DISORDER

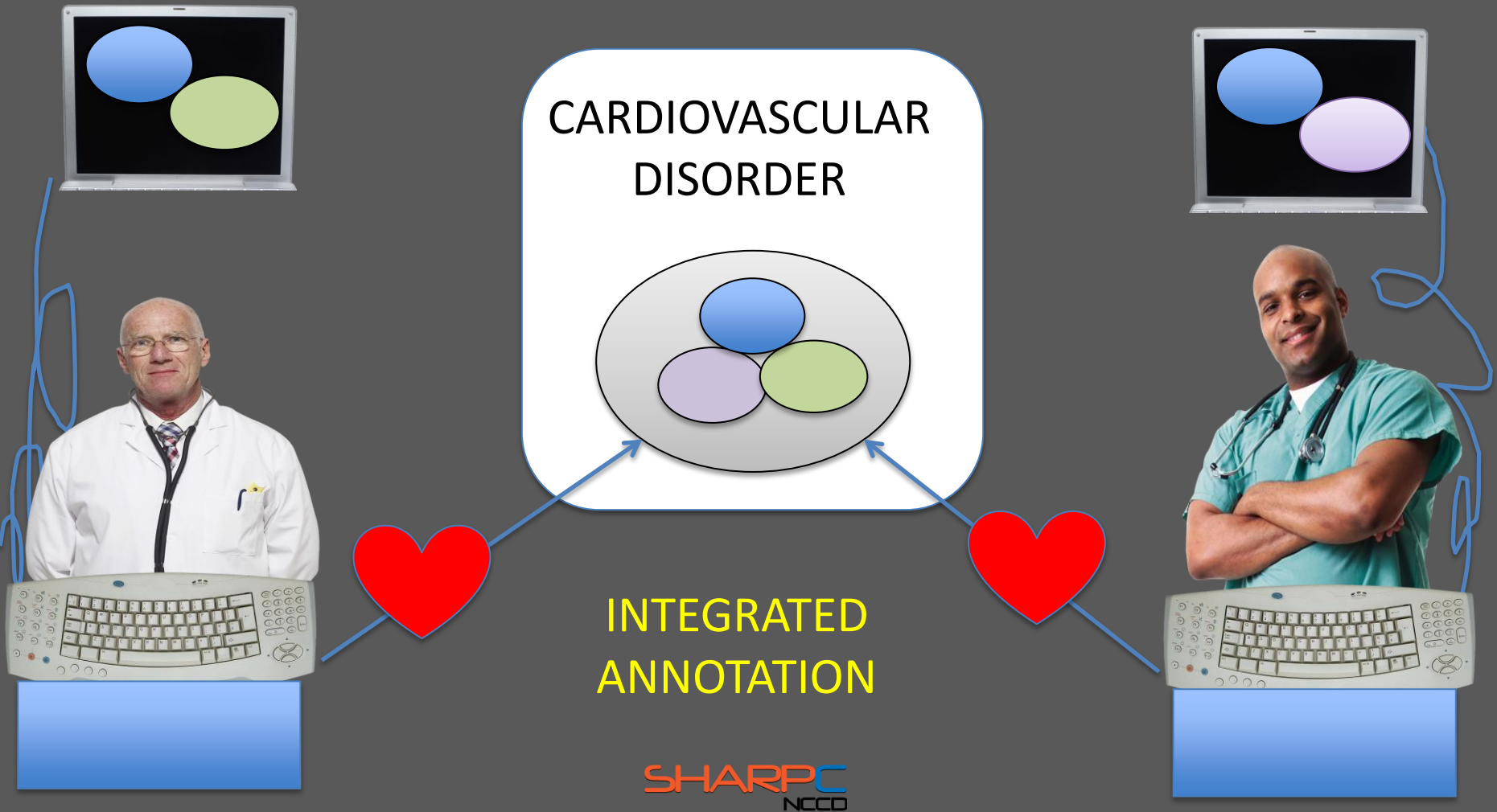


trigger
hypothesis

Computer-aided Knowledge Elicitation



Capturing Clusters: Crowdsourcing?



Supporting Clinical Comprehension

sumframe

file:///Users/tcohen/fakesums/04_04_02sumframe.html

PSYCHOSIS	MOOD	SUBSTANCE	DANGER
<ul style="list-style-type: none">with <u>Psychotic Features Schizoaffective Disorder PTSD</u>about her agitation she claimed "the voices made me do it."	<ul style="list-style-type: none">past diagnoses including <u>Bipolar Disorder</u>from depression and having <u>flashbacks</u>	<ul style="list-style-type: none">against the wall and abusing opiate analgesicsand alcoholThe patient denies any	<ul style="list-style-type: none">to kill herself by cutting her wriststo a past sexual assault

Admitted
04/04/2002

Discharged
04/15/2002

OPERATION DATE

DICTATED BY
Ana Smith MD

ATTENDING PHYSICIAN
Ana Smith MD

IDENTIFYING DATA
This is a 29-year-old Caucasian divorced woman living with her parents and who is a single mother of a 8 year-old son
She is currently on SSI

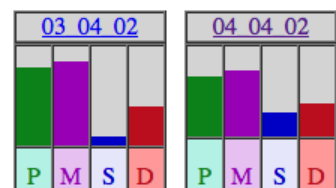
HISTORY OF PRESENT ILLNESS
This is the second Allen Pavilion admission and the eighteenth psychiatric admission for this patient
The patient has had a number of past diagnoses including Bipolar Disorder **with Psychotic Features Schizoaffective Disorder PTSD** and Borderline Personality Disorder
The patient had brought herself into the CPMC ER on March 2, 2002 with the chief complaint of hearing a voice commanding her to kill herself by cutting her wrists
She also stated at that time that she was suffering from depression and having flashbacks to a past sexual assault

04 04 02

PSYCHOSIS

HISTORY OF PRESENT ILLNESS:

- with Psychotic Features Schizoaffective Disorder PTSD
- about her agitation she claimed "the voices made me do it."



Supporting Clinical Comprehension

sumframe
file:///Users/tcohen/fakesums/04_04_02sumframe.html

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MOOD

HISTORY OF PRESENT ILLNESS:

- past diagnoses including Bipolar Disorder
- from depression and having flashbacks
- She endorsed racing thoughts but denied change

03 04 02

P	M	S	D
---	---	---	---

04 04 02

P	M	S	D
---	---	---	---

Supporting Clinical Comprehension

Overview

Name: John Smith

ID: 11686

Bed: 291

Demographics

Age: 81

Ethnicity: Pacific Islander

Gender: Male

Weight: 69.3 kg

Chief Complaint: SOB

Admit Date: 12/5/2016

Last Attended: 17:00

SIRS

- Heart Rate
- Respiratory Rate
- Temperature
- WBC Count **(HIGH)**

Infection

- Fever
- Abnormal Mental State
- Abscess
- Acute Abdomen

Sepsis





- SIRS
- Infection

Organ Failure

- Heart Failure
- Kidney Failure
- Brain Dysfunction
- GI Dysfunction
- Liver Failure
- Respiratory Failure


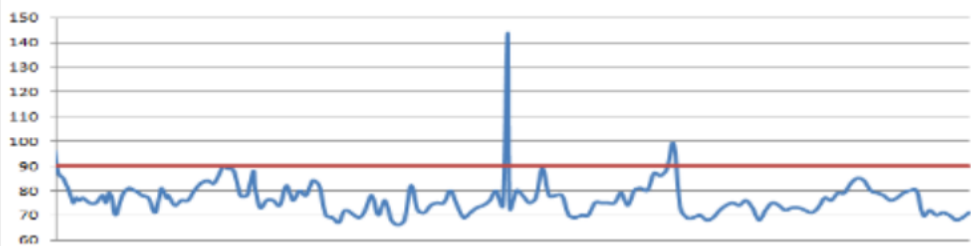
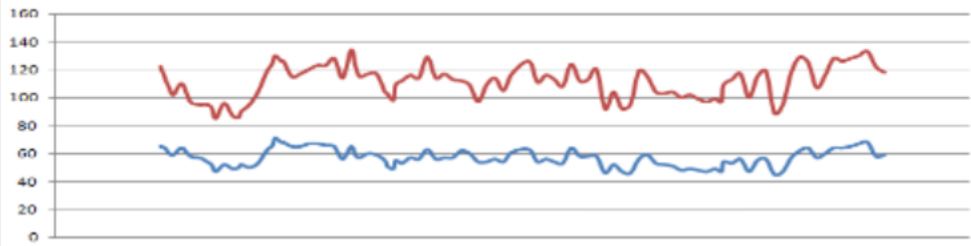
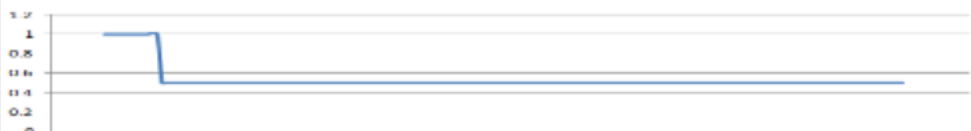
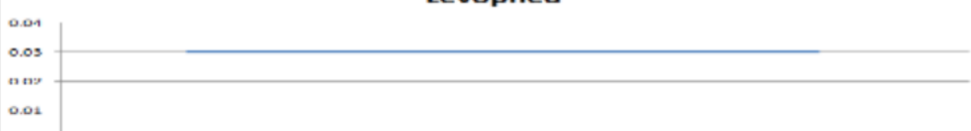



Supporting Clinical Comprehension

Detailed View - SIRS

Patient Select	SIRS <ul style="list-style-type: none">- Heart Rate- Respiratory Rate- Temperature- WBC Count (HIGH) Infection <ul style="list-style-type: none">- Fever- Abnormal Mental State- Abscess- Acute Abdomen Sepsis <ul style="list-style-type: none">- SIRS- Infection Organ Failure <ul style="list-style-type: none">- Heart Failure- Kidney Failure- Brain Dysfunction- GI Dysfunction- Liver Failure- Respiratory Failure	Heart Rate 17:00 12/11/2016 71 beats/min 
Overview		Respiratory Rate 17:00 12/11/2016 17 breaths/min 
Exit		Temperature 12:00 12/11/2016 36 deg C 
		White Blood Cell Count 02:55 12/11/2016 15.5 cells/mm3 (HIGH) 

Supporting Clinical Comprehension

Detailed View - Heart Rate

Patient Select	SIRS Infection Sepsis Organ Failure	<u>Heart Rate</u> 71 	   
Overview		<u>Respiratory Rate</u> 17 	
Exit		<u>Temperature</u> 36 	
		<u>WBC Count</u> 15.5 	

Conclusions

- Support for clinical comprehension
- Characterizing constructs
 - Human-intensive vs. computer-aided
- Cognitive support systems
 - Mediate decision making
- Effects of cognitive support
 - Investigations underway

Acknowledgement

- SHARP 2A team:
 - Thomas George Kannampallil
 - Amy Franklin
 - Khalid Almoosa, Bela Patel, John Joe, Kevin Hwang (domain expertise)
 - Zhe Li (computer-aided elicitation engineer)
 - Katie Vasser (interface design)
 - Ram Vedam (back-end wizardry)
 - Dinesh Gottipatti, Rashmi Mishra
- Vimla Patel :
 - Comprehension and problem-solving