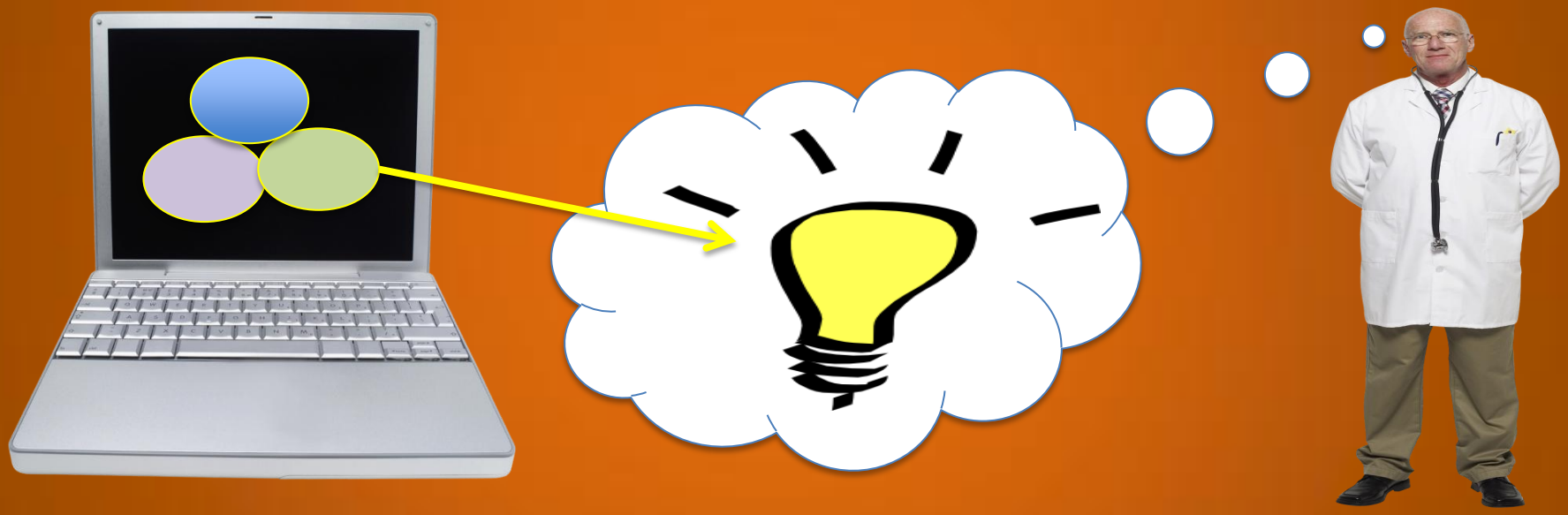
Cognitive Support for Clinical Comprehension



Trevor Cohen, MBChB, PhD

SHARPC NCCD

UTHealth™
The University of Texas
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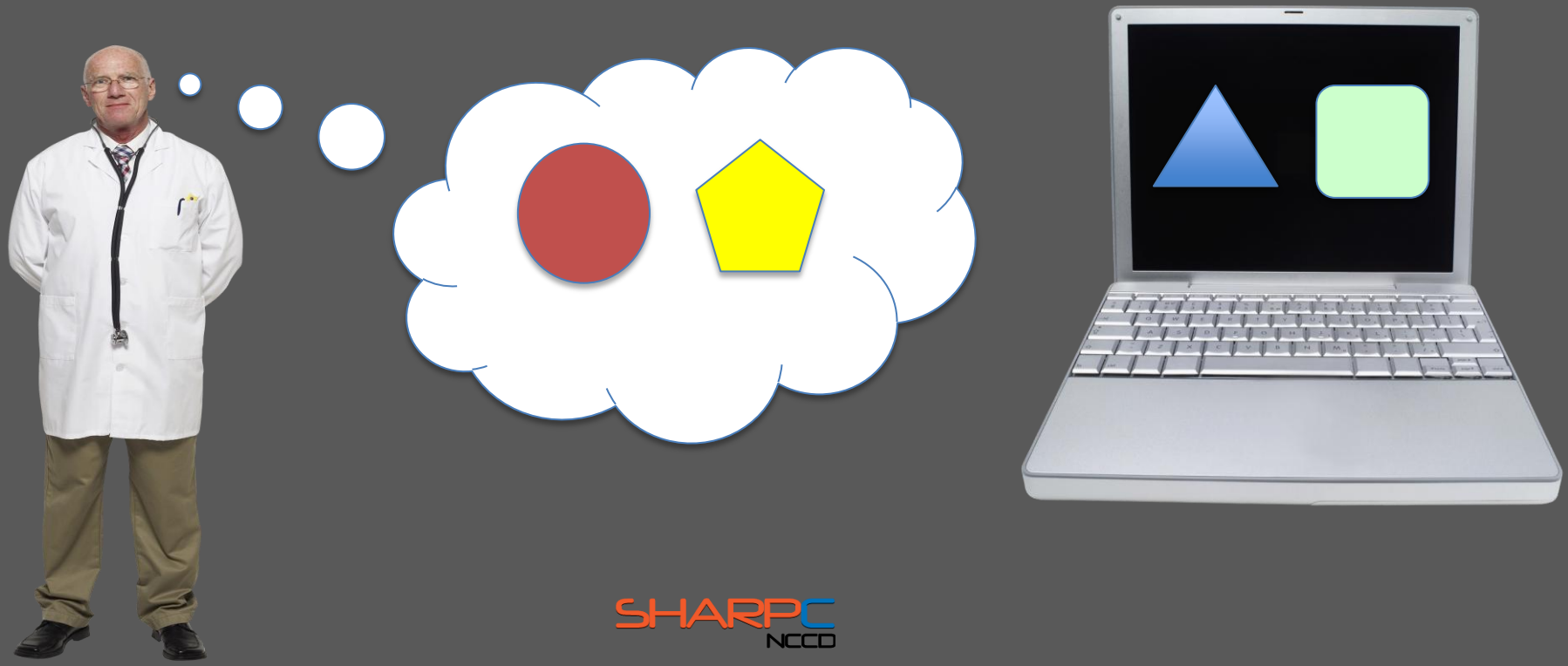
School of Biomedical Informatics

Distributed Cognition: HCI Implications

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



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HIT Implications : Division of Labor

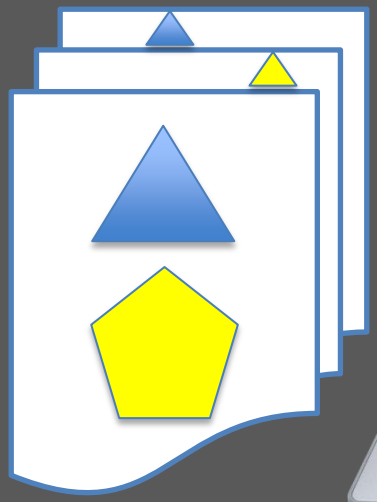
- Finite attention
- Limited time

SYNTHESIS

AGGREGATION

SEARCH

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



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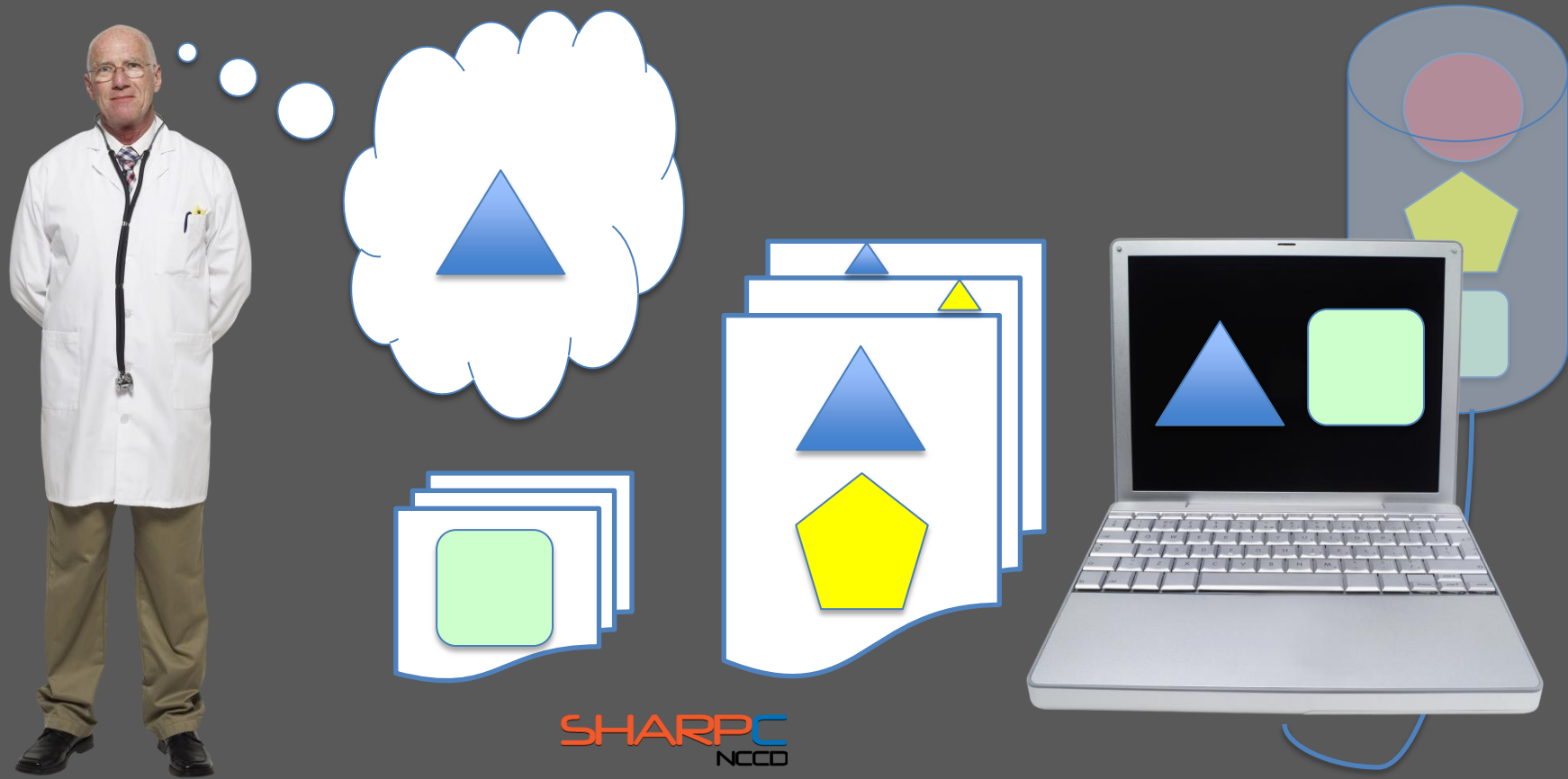
Distributed Cognition

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



Division of Labor

PROBLEM SOLVING

COMPREHENSION

SYNTHESIS

AGGREGATION

SEARCH

STORAGE / RETRIEVAL

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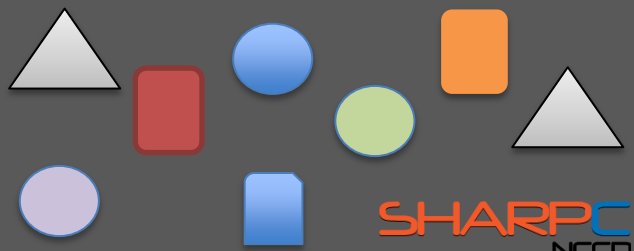
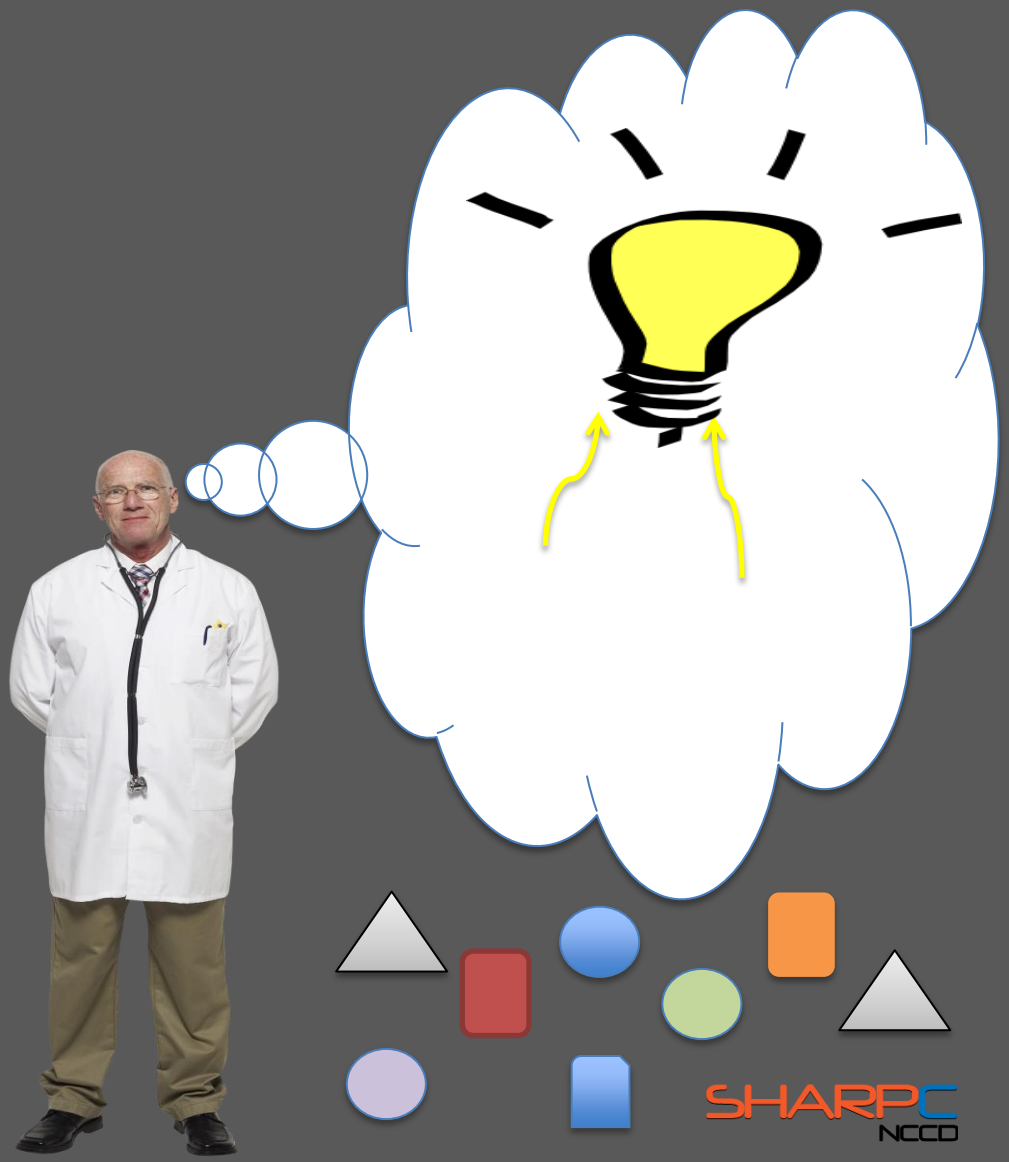
Clinical Comprehension : A Prerequisite to Problem Solving

- Patel *et al* 1994



Observations

Meaningful Clusters



- Patel *et al* 1994

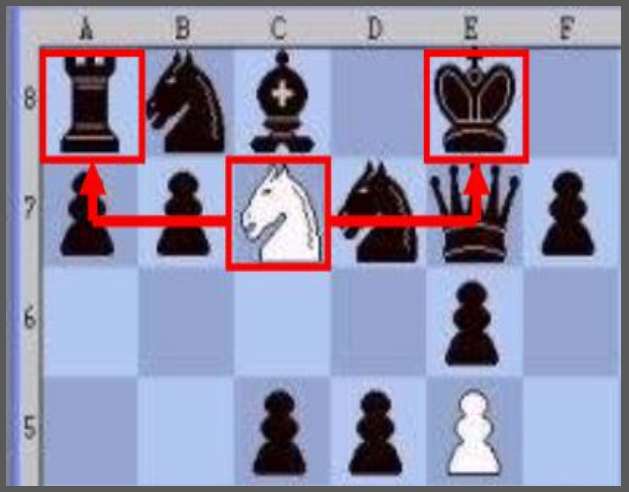
Diagnosis

Clusters of findings
(intermediate constructs)

Observations

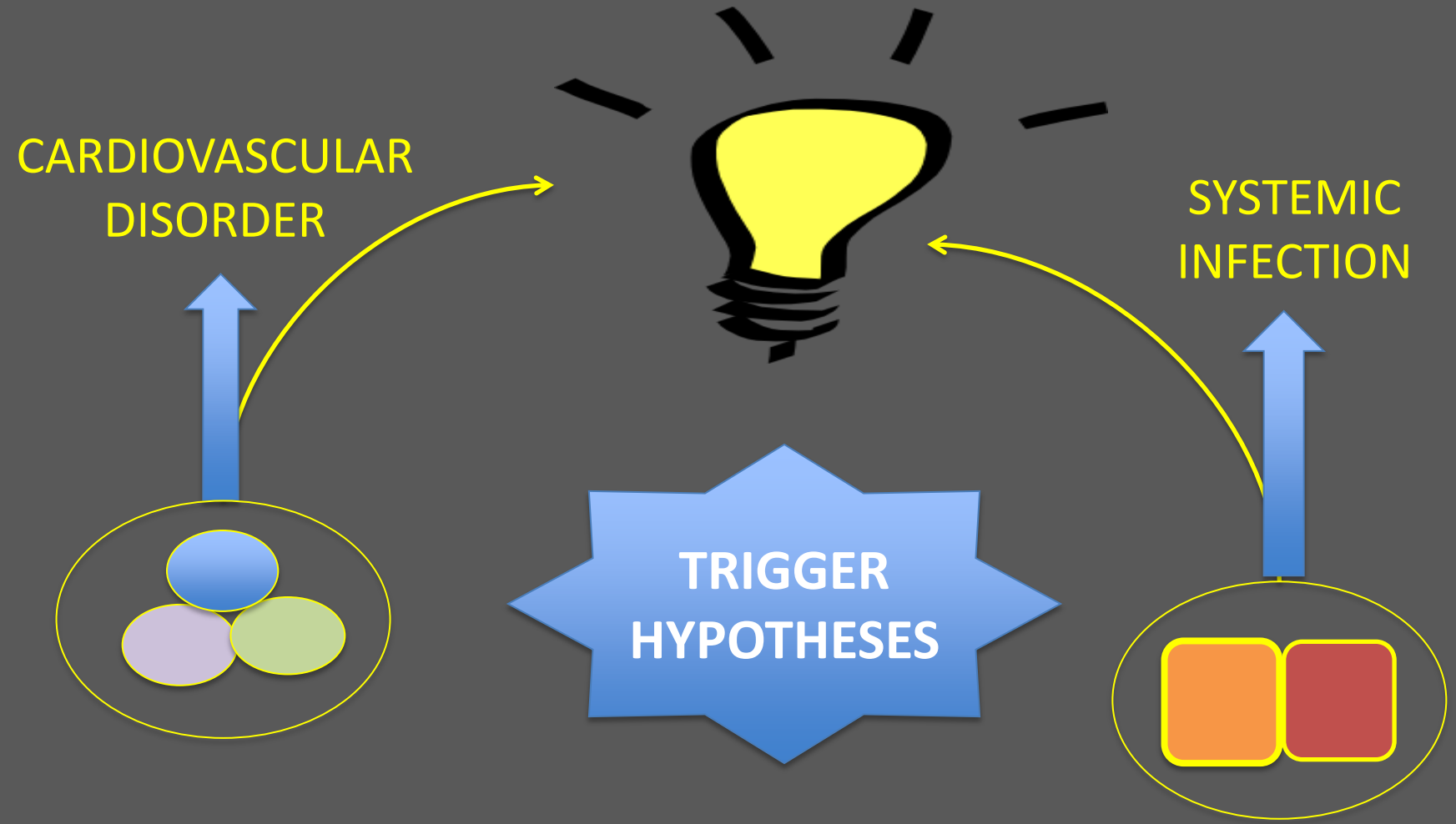
Perception and Expertise

- Recognize and remember meaningful patterns
  - DeGroot (1965)
  - Chase and Simon (1973)

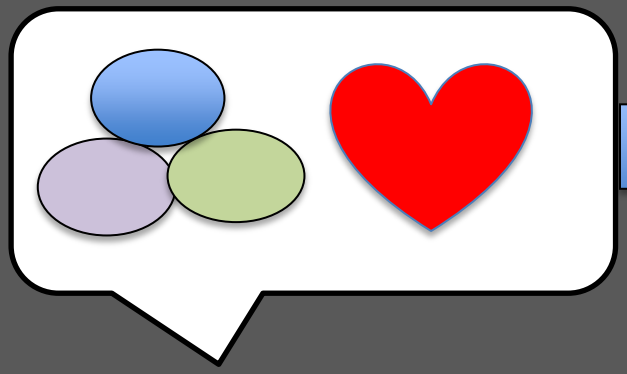


- Represent problems in a deeper, more principled manner
  - Physics: Chi Feltovich and Glaser (1991)

Purposeful Clusters



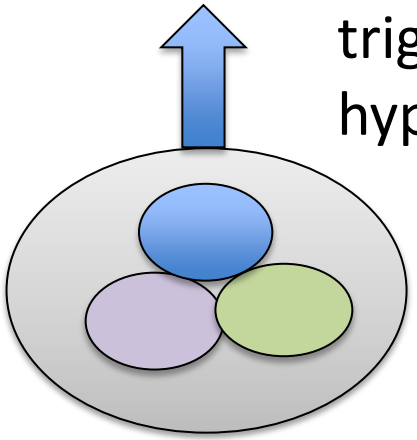
Capturing Clusters: Human-intensive Methods



RECORDING
TRANSCRIPTION
ANALYSIS

CARDIOVASCULAR DISORDER

trigger hypothesis



FINITE NUMBER OF COGNITIVE OPERATIONS

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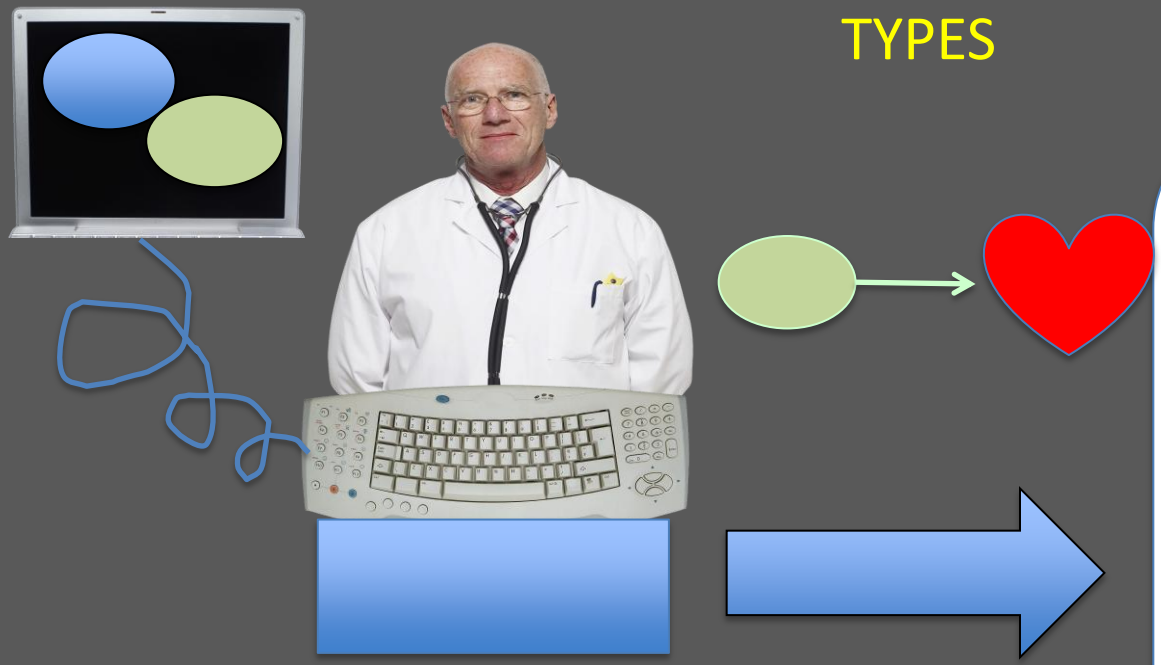
Capturing Clusters: Computer-aided Knowledge Elicitation

DEIDENTIFIED CLINICAL DATA

SUBSET OF RELATIONSHIP TYPES

LESS GRANULAR MORE VOLUME



ANNOTATION TOOL

CARDIOVASCULAR DISORDER

trigger hypothesis

Computer-aided Knowledge Elicitation

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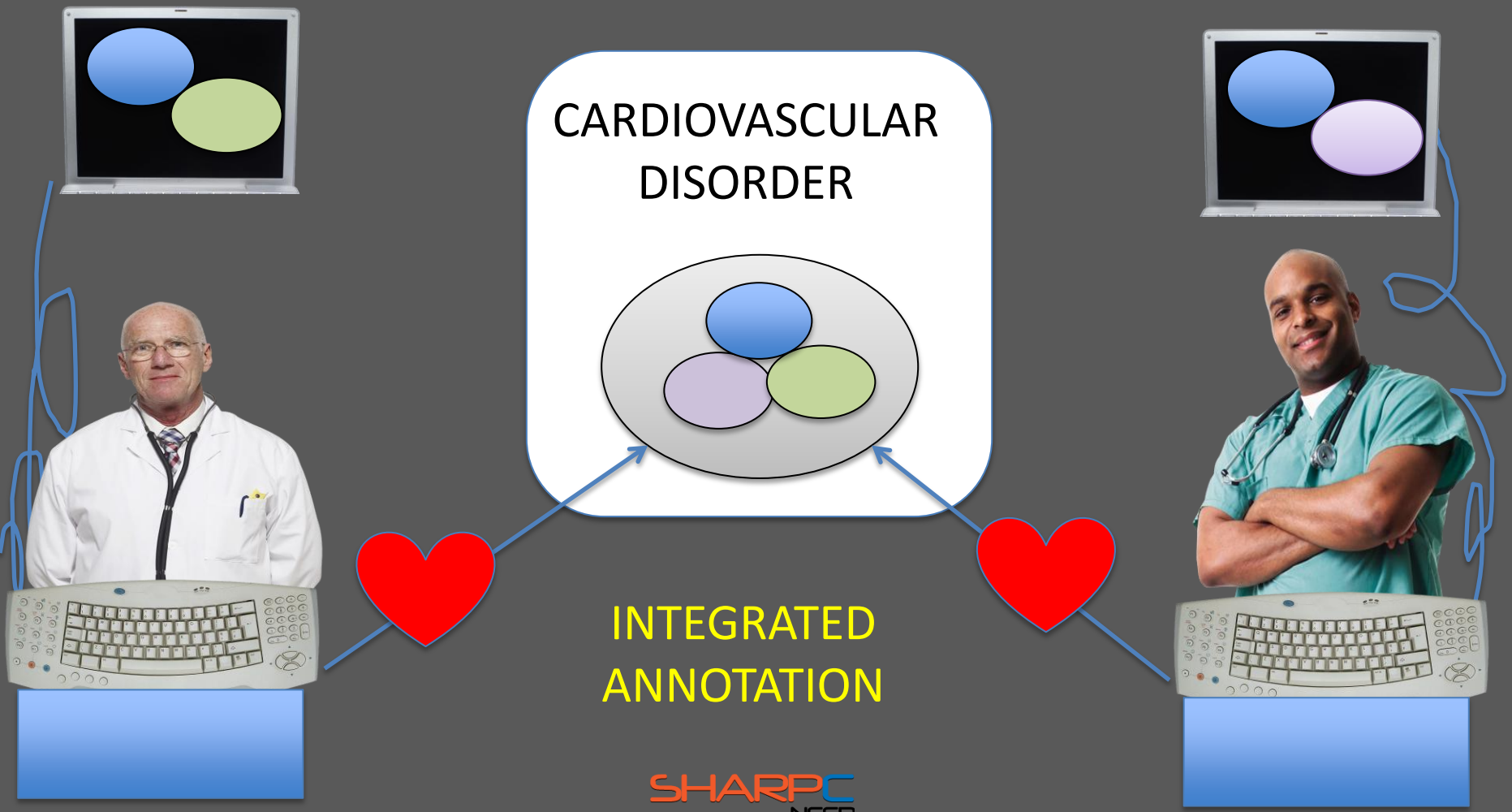
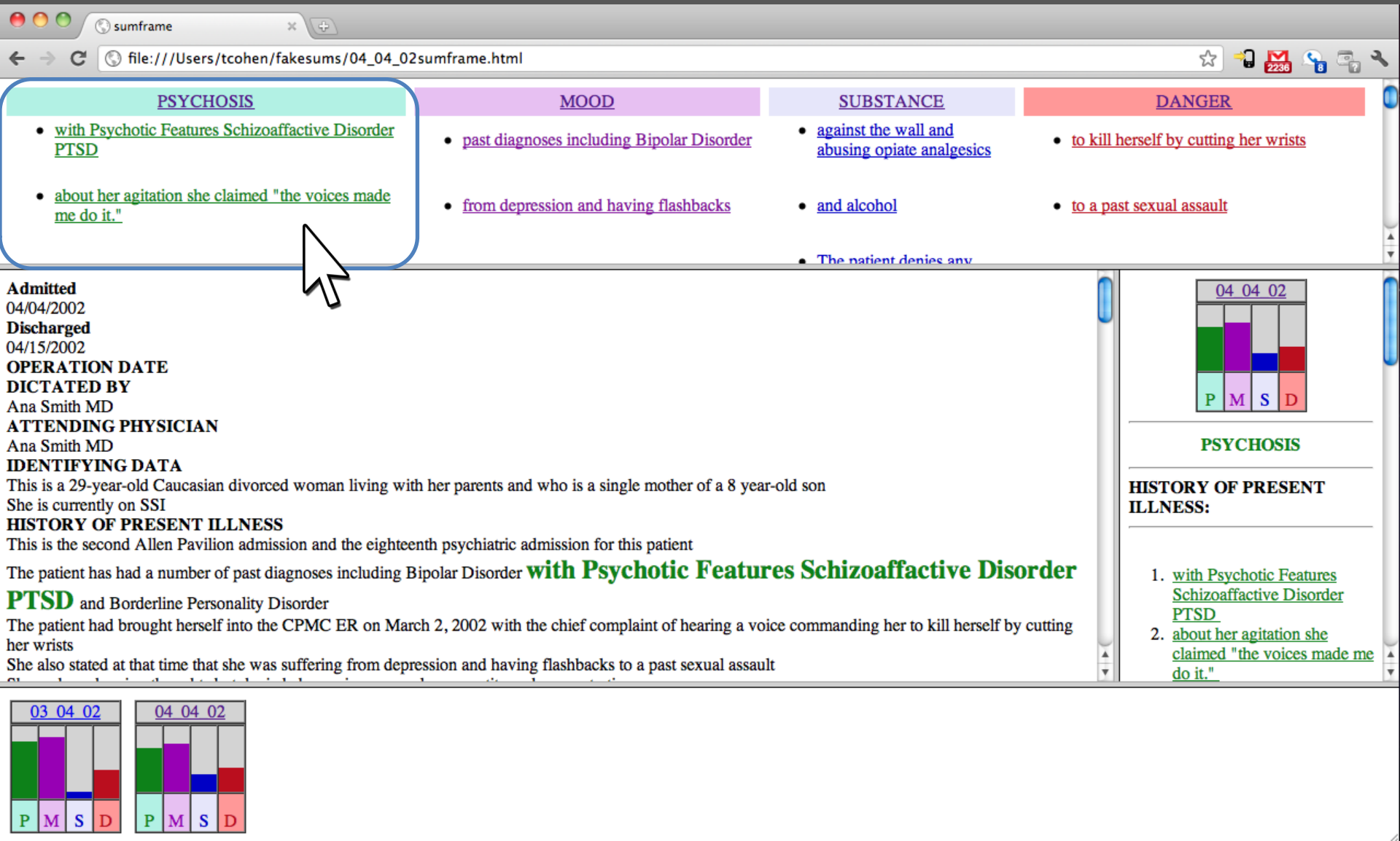
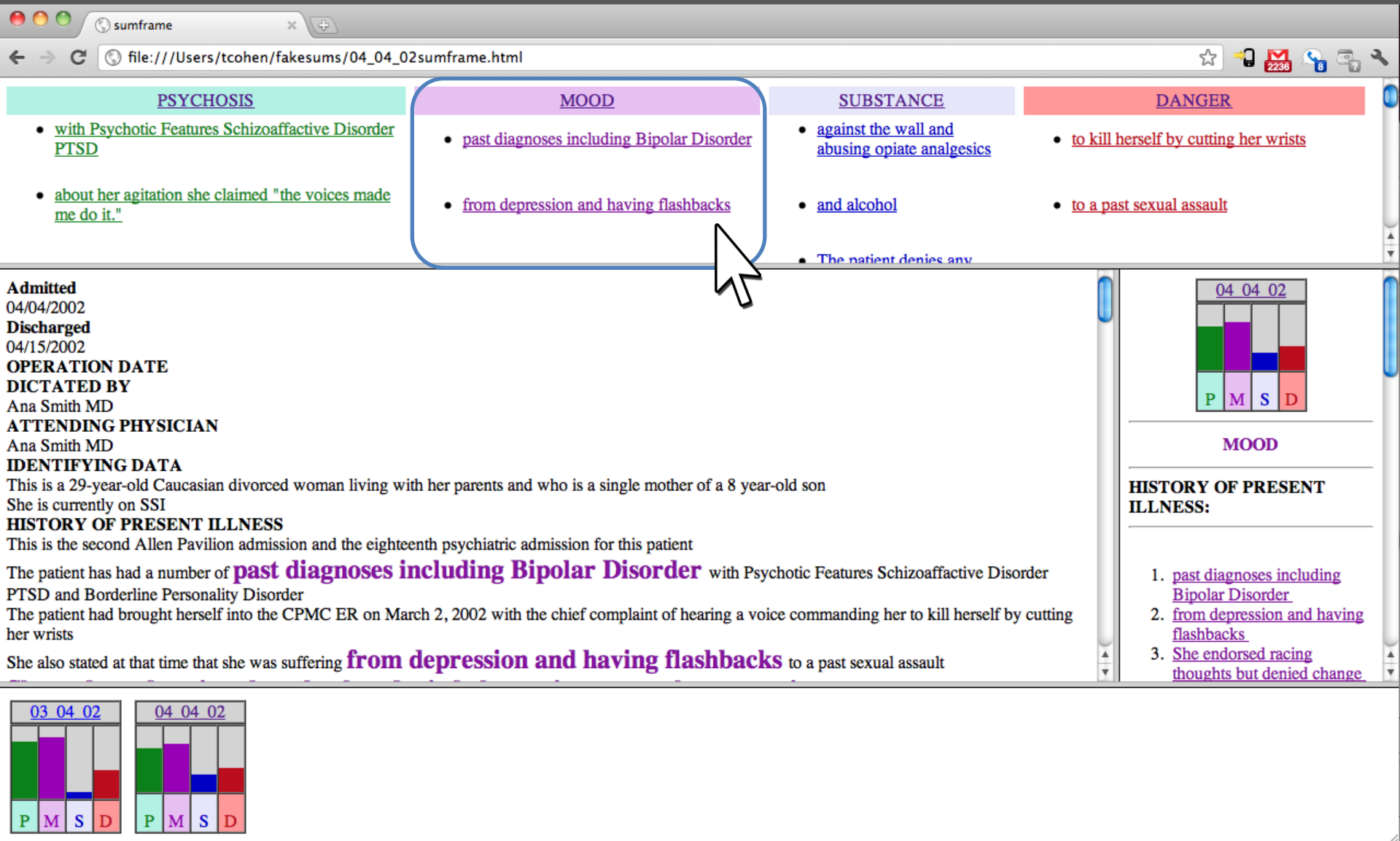
Capturing Clusters: Crowdsourcing?



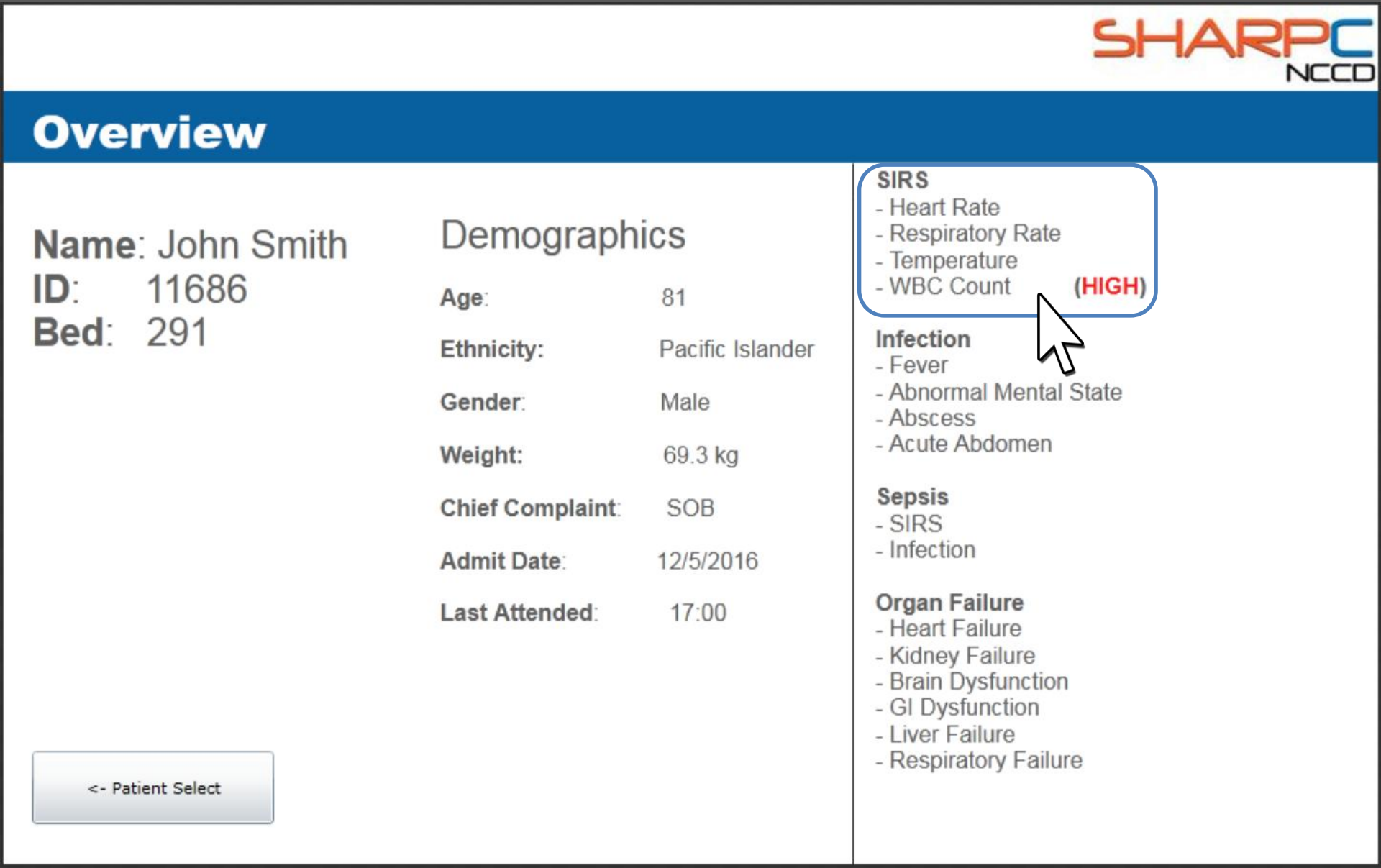
Supporting Clinical Comprehension



Supporting Clinical Comprehension



Supporting Clinical Comprehension



Supporting Clinical Comprehension

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Detailed View - **SIRS**

Patient Select

Overview

Exit

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

Heart Rate

17:00 12/11/2016 **71** beats/min

Respiratory Rate

17:00 12/11/2016 **17** breaths/min

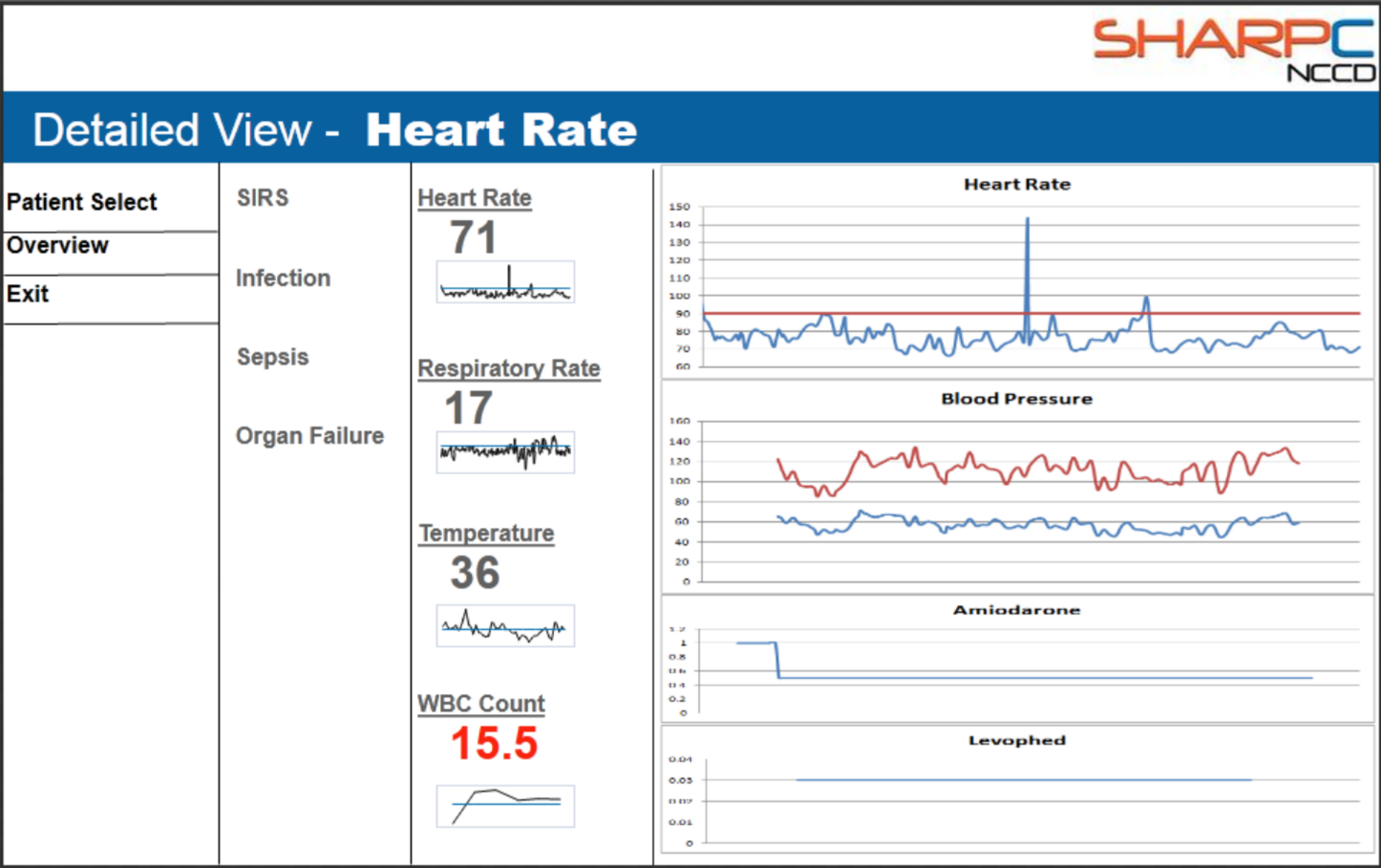
Temperature

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



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)
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  - Comprehension and problem-solving