Cognitive Support for Clinical Comprehension

Trevor Cohen, MBChB, PhD
Distributed Cognition: HCI Implications

• Human-machine system with greater capacity than its component parts
HIT Implications: Division of Labor

- Finite attention
- Limited time
- Redundantly represented
- Temporally organized
- Frequently ignored (Hripcsak et al. 2011)

SYNTHESIS
AGGREGATION
SEARCH
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
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

CARDIOVASCULAR DISORDER

TRIGGER HYPOTHESES

SYSTEMIC INFECTION
Capturing Clusters: Human-intensive Methods

RECORDING TRANSCRIPTION ANALYSIS

CARDIOVASCULAR DISORDER

FINITE NUMBER OF COGNITIVE OPERATIONS

trigger hypothesis
Capturing Clusters: Computer-aided Knowledge Elicitation

DEIDENTIFIED CLINICAL DATA

ANNOTATION TOOL

SUBSET OF RELATIONSHIP TYPES

LESS GRANULAR MORE VOLUME

CARDIOVASCULAR DISORDER

trigger hypothesis
Computer-aided Knowledge Elicitation
Capturing Clusters: Crowdsourcing?

CARDIOVASCULAR DISORDER

INTEGRATED ANNOTATION
Supporting Clinical Comprehension

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

MOOD
- past diagnoses including Bipolar Disorder
- from depression and having flashbacks

SUBSTANCE
- against the wall and abusing opiate analgesics
- and alcohol

DANGER
- to kill herself by cutting her wrists
- to a past sexual assault

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 that at that time that she was suffering from depression and having flashbacks to a past sexual assault.
Supporting Clinical Comprehension

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

**MOOD**
- past diagnoses including Bipolar Disorder
- from depression and having flashbacks

**SUBSTANCE**
- against the wall and abusing opiate analgesics
- and alcohol

**DANGER**
- to kill herself by cutting her wrists
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**Admitted**
04/04/2002

**Discharged**
04/15/2002

**OPERATION DATE**
04/23/2002

**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 that at that time that she was suffering from depression and having flashbacks to a past sexual assault

1. past diagnoses including Bipolar Disorder
2. from depression and having flashbacks
3. She endorsed racing thoughts but denied change
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

<table>
<thead>
<tr>
<th>Patient Select</th>
<th>SIRS</th>
<th>Overview</th>
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<td>Heart Rate</td>
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<td>Respiratory Rate</td>
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<td>Temperature</td>
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<td>WBC Count (HIGH)</td>
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### 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

### Detailed View - Heart Rate

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<td><strong>15.5</strong></td>
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- **Heart Rate**: 71
- **Respiratory Rate**: 17
- **Temperature**: 36
- **WBC Count**: 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

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