Contextualizing Clinical Information

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Contextualizing clinical information ...
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... is in the given situation to separate the relevant from the non-relevant, and to gather the relevant into a coherent context.
Q1: Is it possible to depict the doctor's clinically logical structure of contextualized information?
The health record in the Capital Region of Denmark
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.. is a source-oriented and fragmented mixture of digital and paper-based data

{Bansler, Havn, et al. A study of the fragmentation of the medical record. 2012.}
Logical sections of the fragmented health record

- **Health record**
  - Electronic board
  - Progress notes
  - Nurse documentation
    - EWS chart
    - Fluid balance chart
    - Nursing care plan
  - Medication list
  - ECG
  - Telemetry monitoring
    - Real-time monitor
    - Trend analysis
  - Microbio. lab results
  - Biochem. lab results
  - Radiology info. system

- **Most important diagnoses, isolation status**
- **Narrative about past and present illness and therapy**
- **Vital signs, including SAT & temperature**
- **Patient's intake and output, including IV-fluids**
- **Nursing assessment, planning, and evaluation**
- **Past and present medication**
- **Monitor-ECG**
  - ECG waveform and arrhythmia analysis
- **Various cultures of blood, urine, stool, etc.**
- **Various tests for antibodies and pathogens**
- **Various biochemical analysis of blood, urine, etc.**
- **On-screen image access, radiology reports**

![Digital, Paper-based, Both]
Contextualizing clinical information ...

Q1: Is it possible to depict the doctor's clinically logical structure of contextualized information?
Q2: How does the fragmented structure of the health record support the doctor's contextualisation?
Methods and materials

Video-supported observation of doctors in the medical department of a 700-bed hospital in the Capital Region of Denmark.

Observation of doctors performing an ordinary task: The experienced doctor's first review of a newly admitted patient.

- The patient's record exists and is loaded with primary results.
- The doctor's objective is to confirm or adjust the current plan for the patient.
- The doctor has a very limited knowledge of the patient → lots of contextualisation.

Eight experienced doctors, 33 patients.

Videosupported "obser-view"

- Simultaneous observation & interview
- Relaxed think-aloud
### Analysis

<table>
<thead>
<tr>
<th>Time</th>
<th>Microbiological lab results</th>
<th>Biochemical lab results</th>
<th>EWS chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:05:20</td>
<td>(opens system)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:06:00</td>
<td>blood culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>stool samples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:06:10</td>
<td>clostridium</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>clostridium test, no result</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:06:43</td>
<td>blood culture negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:06:50</td>
<td>(closes system)</td>
<td>(opens system)</td>
<td></td>
</tr>
<tr>
<td>00:07:23</td>
<td>liver function tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:07:51</td>
<td>WBC count, previous minor decline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:08:02</td>
<td>CRP, no decline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:08:18</td>
<td>treatment without convincing effect</td>
<td>&quot;values&quot;, collects nursing documentation</td>
<td></td>
</tr>
<tr>
<td>00:08:49</td>
<td>varying fever (temperature)</td>
<td>treatment without convincing effect</td>
<td></td>
</tr>
<tr>
<td>00:09:04</td>
<td>EWS (vital signs) OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Registration over time:**

- From which section of the health record is the information contextualized?
- What topic or piece of information is in the doctor's mental focus?
The structure of contextual information

Observed topics was assembled ...

... into a clinically logical information structure
Some patients are more complex than others. So are the resulting maps of contextual clinical information.
Some patients are more complex than others.

None of the 33 maps had any resemblance to the health record's structure.

So are the resulting maps of contextual clinical information.
Typical plot of contextualized topics vs. time

Diarrhea
- Development
  - Exposure
- Progression
  - Bowel movements
- Fluid status
  - Vital signs, hemoglobin, electrolyte status, renal function parameters, fluid balance, intravenous fluids
- Infection
  - Infection parameters, microbiology, antibiotics, isolation
Split-attention occurs when persons are required to split their attention between two or more mutually dependent sources of information (e.g., text and diagram), which have been separated either spatially or temporally.

{{Chandler, Sweller. The split-attention effect as a factor in the design of instruction. 1992.}}
Typical use of the health record for contextualization

Health record

- Electronic board
- Progress notes
- Medication list
- Microbio. lab results
- Biochem. lab results
- Nurse documentation

Digital
Paper-based
Both

\( t \)
Typical use of the health record for contextualization

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Generally, the doctors "read" the health record one section at a time.
Typical use of the health record for contextualization

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Conclusions...

Q1: Is it possible to depict the doctor's clinically logical structure of contextualized information?

A1: The obseview method makes it possible to depict the coherent, contextualized clinical information in the form of a mind map. However, one must be aware that
- the method requires the observer's understanding of the domain
- the interactivity makes the results susceptible to observer bias.
Conclusions...

Q2: How does the fragmented structure of the health record support the doctor's contextualisation?

A2: Poorly!

- The shift between sections of the health record gave rise to idle time and stress.
- The general picture was characterised of split-attention.
- Doctors were observed to actually forget topics.
Thank you for your attention!
Outtakes and bonus material
The better health record?

Progress notes as the basic narrative. Access to general topic-oriented views.

- **Diarrhea**
  - Development
  - Exposure

- **GI-view**
  - Progression
  - Bowel movements

- **Fluid status view**
  - **Fluid status**
    - Vital signs, hemoglobin, electrolyte status, renal function parameters, fluid balance, intravenous fluids

- **Infection view**
  - **Infection**
    - Infection parameters, microbiology, antibiotics, isolation
The better health record?

General topic-oriented views made out of topic-oriented building blocks.
The better health record?

A single topic-oriented view versus five look-ups in different sections of the health record.
Outtakes and bonus material
Semantic network versus mind map - what's the difference?

Clinical information used for diagnostic reasoning and depicted as a semantic network. From: Patel, Groen, et al. Medical expertise as a function of task difficulty. 1990, figure 1, pg 397.

Contextualised clinical information depicted as a mind map. From this study.
Semantic network versus mind map - what's the difference?

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Diagnostic reasoning based on cases - i.e. in-vitro study of a single process vs. Doctors' mental work on the production line - i.e. in-vivo study of mixed processes.
Semantic network versus mind map - what's the difference?

Clinical information used for diagnostic reasoning and depicted as a semantic network.
From: Patel, Groen, et al. Medical expertise as a function of task difficulty. 1990, figure 1, pg 397.

Depicts only those pieces of information essential to the diagnostic process.

Contextualised clinical information depicted as a mind map. From this study.

Depicts (potentially) all the contextualized information.

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**Clinical Information**

- **Acute Bacterial Endocarditis**
  - Intravenous Drug Abuse
  - Puncture Wound
- **Infectious Process**
  - Fever of 4 days duration with malaise
- **Cardiac Insufficiency**
  - Shortness of breath on exertion
  - Acute Diastolic Murmur
- **Embolic Phenomena**
  - Transient Visual Loss
  - Flame-Shaped Hemorrhage

**Patient Information**
Pl. #002
85-year old male

**Compliance**
- Advanced dementia
- Functional ability
- Level of consciousness

**Desaturation**
- Need for supplemental oxygen

**Expectoration**
- Need for suction

**Progression**
- Infection parameters
  - CRP
  - Body temperature

**Type**
- Chest X-ray

**Antibiotics**
- Administration
- Dose

**Aspiration Pneumonia**
- Type
- Need for U-cath
- Contact urologist

**Eczema cruris**
- Causative agent
- ? Scabies

**Non-categorised information**
- ECG
- "Lab results"
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Relations symbolize specific inference vs. Relations symbolize simple subsuming