Integrating users' activity modeling in the design and assessment of hospital electronic patient records: the example of anesthesia

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Overall Concept

Theoretical: Standard, task-oriented, usability studies do not allow for the identification of major cognitive problems. To develop an effective health information interface, you need to look at the “complex cognitive processes underlying the actual activity.”

Practical: The management of health information is closely tied to physician’s activity. To be effective, health information systems must easily integrate into anesthesiologists’ daily work environments and take into account the cognitive processes underlying their daily activities.

Introduction

- Current Hospital Information Systems (HIS) do not meet the needs of anesthesiologists
- Previous attempts to develop HIS for anesthesiologists have failed:
  1. Systems once designed to only record physiological parameters
     - Emphasis on saving time
  2. Small prototypes developed by single anesthesiologists for managing patient information
     - Transferability problems

Activity Study: Consultation

- Main goal is to ensure patient survives surgery
- Planning is based on a “schematic representation” of the patient’s medical case
- Anesthetic process phases: pre-operative preparation; induction; maintenance; and survey of the recovery phase. In the pre-operative phase, other phases are planned.
  - Pre-operative file is a legal document in many countries

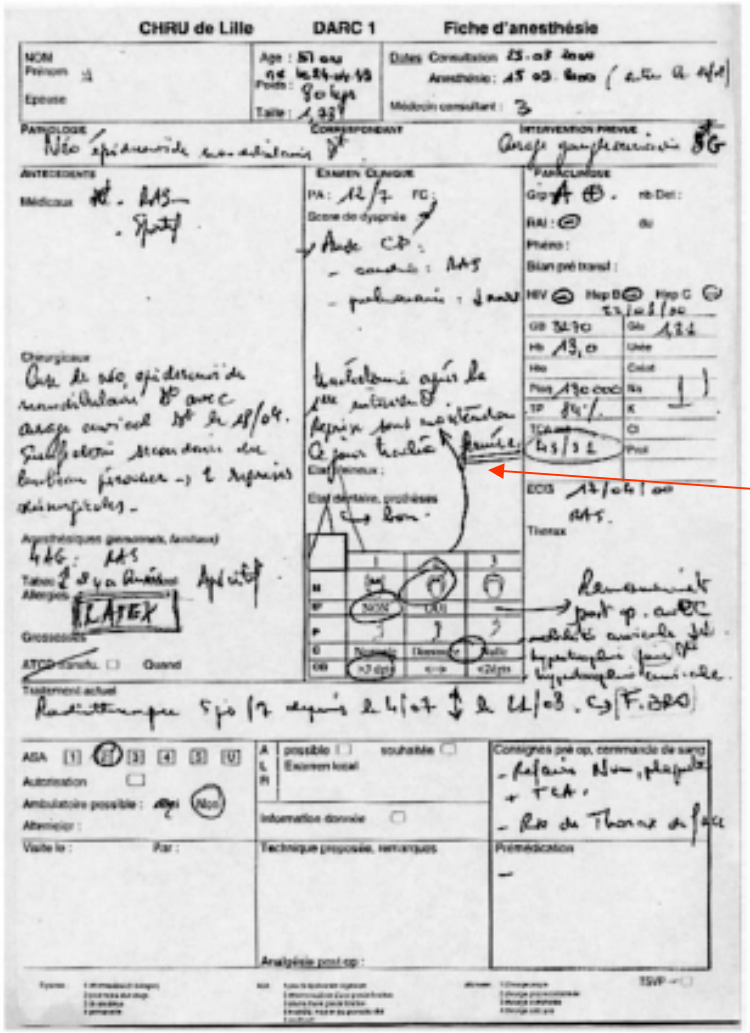
Activity Study: Research

- Observation, description, and analysis of anesthesiologists' activity during patient interviews
  - Employed interviews, video, audio recording, and auto-facing interviews
- 13 anesthesiologists participated: 11 experienced, 2 novices
- Each anesthesiologist had one simple and one complex case. Up to 50 consultations were recorded with trained actors.

Activity Study: Results

- Anesthesiologists write on one page with nine fields during an interview. Each field is divided into zones, and each zone is devoted to one physiological system.
  - Abbreviations are used, the anesthesiologists jumps around on the page during the interview.
    - In a study at the University Hospital of Lille, 8 percent of files contained at least one undecipherable data. A lot of files were also incomplete.
  - Most anesthesiologists try to emphasize some information – 12.26 percent contained explicit alarm signals, 20 percent had highlighted data, and 48 percent contained emphasized data (underlined).

Results


CHRU de Lille
DARC 1
Fiche d'anesthésie
Page is broken into 9 zones
Alarm signal
Underline

Information Gathering Strategies

- Anesthesiologists use 3 different interview procedures, which vary depending on case complexity and how the anesthesiologist chooses to explore the patient's medical background.
  1. The anesthesiologist follows a standard and systematic order
  2. From an answer given by the patient, the anesthesiologist infers information and sets specific questions to confirm the hypothesis
  3. The anesthesiologist lets the patient "tell his story" as far as it is relevant to the consultation

  * Novices only use 1.

Novice vs. Expert

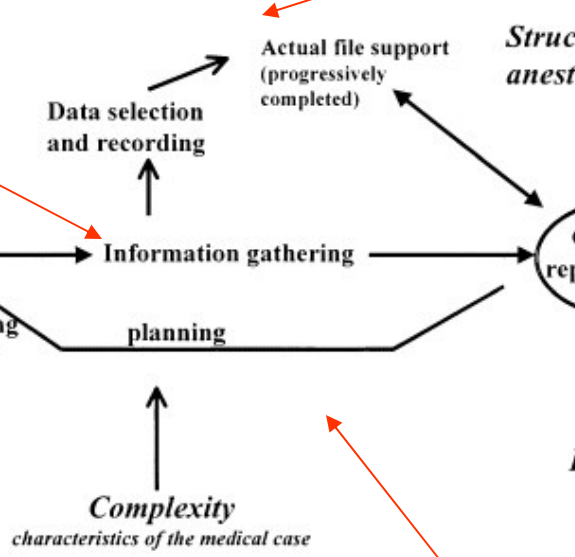
Novice:

- Follows systematic order
- Asks all the questions
- Writes down all answers
- Does not interpret differences
- Does not emphasize
- Does not plan for the anesthesia itself
- Reassures patient
- Does not use natural dialogue

Expert:

- Does not use standard order
- Jumps from field to field
- Writes only relevant data
- Interprets differences
- Emphasizes crucial information
- Gives clues for the planning of anesthesia

Interpretation of the Model



File becomes a type of external support, imposes categorization

Gather relevant information

Standard beginning

New information feeds new representation

Level of expertise changes how much analysis is done

Plans search for more information. Influenced by complexity

Constraints & Recommendations

Constraints:	Consequences:	Recommendations:
The anesthesiologist relies on the progressing representation of the patient's medical framework to drive the clinical interview. The paper file acts as an external support for this representation.	All along the clinical interview, the anesthesiology must have before his eyes all the data gathered. At least, he must be able to access this information very rapidly.	The software must provide the physician with a summary screen page, continuously updated with each new data and always available while he questions the patient and enters new data.
The anesthesiologist relies partly on the structure of the paper file to plan the clinical interview and to categorize the items.	The anesthesiologist must have this structure before his eyes all along the interview.	The summary screen page must include this structure. Each new data must be entered in the proper field or zone of the structure. The order of data gathering set by default should follow this structure.
Expert anesthesiologists particularize the interview according to the characteristics of the patient's medical framework.	The anesthesiologists must be able to jump from one field to another in order to enter a new data easily and rapidly enough to deal with the speed of a natural dialog.	The software must allow the physician to enter the data randomly and very rapidly. If the software contains several screens and catalogs, the shift from one screen to the other must be easy and fast.
Expert anesthesiologists may transmit the anesthesiologist on duty for the surgery interpreted data, part of their representation of the medical case and elements of planning.	Expert anesthesiologists underline, circle or emphasize important data, sometimes they add alarms.	The software must allow the anesthesiology to emphasize crucial data and set specific alarms.

Case: Tabellar

Developed for one anesthesiologist at University Hospital of Lille. Main user is system's author.

- Structure is similar to paper file
- Interface closely linked to database
- Interface has more than 10 screens. User has to quit to get back to the synthesis page
- Anesthesiologist can jump from category to category
- No way to emphasize information

Case: Tabellar Hypothesis

-Anesthesiologists should be able to gather and record the relevant data while performing their consultation. The resulting record should be satisfactory.

-Expert anesthesiologists should feel uncomfortable with the interface because they cannot rely on experience when interviewing

-Expert anesthesiologists should be less bothered by the interface when dealing with simple cases than with complex ones

Table 2
A priori assessment of the Tabellar application

Recommendation	Tabellar interface
Dynamically updated synthesis screen page	Medium
Possibility of particularizing the order of data gathering	Low
Visibility of the structure for data gathering	Good
Possibility to emphasize crucial data	Low

Case: Tabellar

Experiment:

- Subjects: one expert anesthesiology unfamiliar with Tabellar; two novice anesthesiologists unfamiliar with Tabellar; and one expert anesthesiologist familiar with Tabellar

- Each anesthesiologist performed four consultations with different complexity (Simple/Complex) and wrote on two different interfaces (Tabellar/Paper)

Case: Tabellar Results

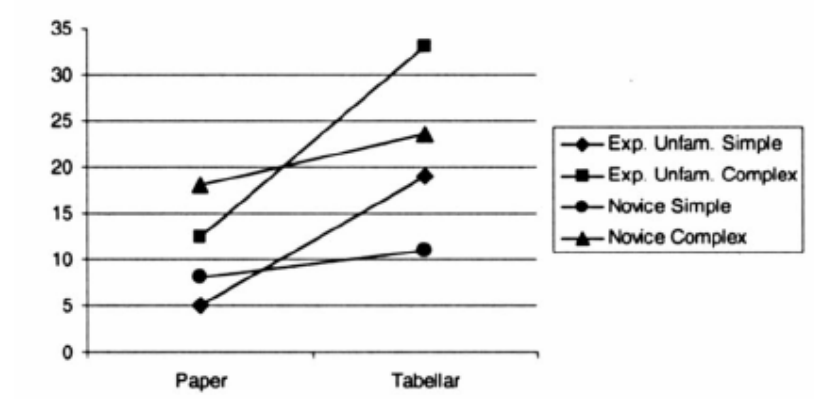
Table 3
Duration of the consultation (in minutes) according to the expertise, the complexity and the file support

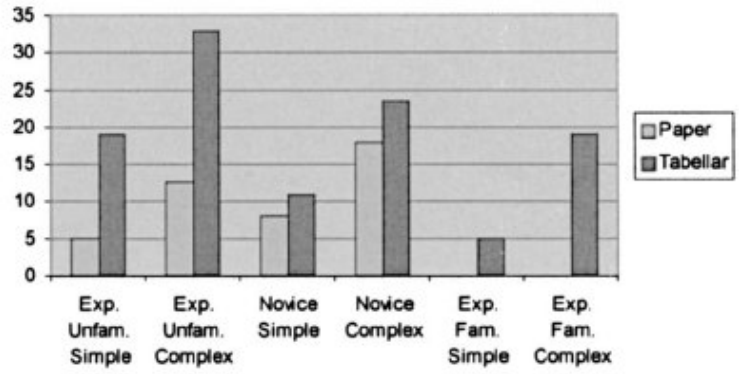
Conditions/ subjects	Expert anesthesiologist familiar with the application	Expert anesthesiologists unfamiliar with the application	Novice anesthesiologists unfamiliar with the application
Simple case Paper file		5 min = max = 5	8 min: 7; max: 9
Simple case Tabellar	5	19 min: 14; max: 28	11 min: 9; max: 13
Complex case Paper file		12.5 min: 4.5; max: 18.5	17.5 min: 17; max: 18
Complex case Tabellar	19	33 min: 20; max: 46	23.5 min: 22; max: 25

- Consultation with the paper file and for simple cases is always faster than consultation with the computer for complex cases.

- Expert anesthesiologists were faster than novice anesthesiologists unfamiliar with Tabellar

Case: Tabellar Results





Findings:

- The expert anesthesiologists are always faster at using paper than their novice counterparts
  - Novices enter less data on the computer and this data is less precise
  - Expert anesthesiologists feel “less in control”
  - Nurses find it easier to read Tabellar output

Case: Tabellar Results

Table 4
Differential efficiency of the computer and paper files according to the functionalities considered

Functionalities/support	Paper	Computer
To support the activity:		
Elaboration of the representation	++	−−
Information gathering	++	−−
Transmission of interpreted information (representation)	+	−
Transmission of raw information	+−	++
Data management:		
Archiving	−−	++
Statistics	−−	++
Data retrieving and data availability	+−	++
Editions, complementary services	−−	++

Other Findings:

- Tabellar is better for sharing information, providing statistics, and archiving

Case Conclusion: Tabellar

- The results of the experiment verified the hypothesis from the activity study and priori model

-Problems of usability are due to “the incompatibility between the software application and the main characteristics of the anesthesiologists activity.”

-Specifically, Tabellar does not account for:

-Strategies for information gathering

-Strategies for transmitting the relevant information

Conclusion

- As more anesthesiology records become computerized, the software associated with them must account for the daily working environment of anesthesiologists.

- Anesthesiology software needs to: (1) provide a reliable archive and; (2) support anesthesiologists' activity, cognitive models, and documentation methods.

- While most existing software does a good job of (1), more work is needed to achieve (2).

Questions

-Was the sample size of anesthesiologists studied large enough in the activity study? What about in the Tabellar case?

-How could Tabellar solve the novice vs. expert interface problem? Should the designers accommodate the needs of both groups?

-What alternative methods could the authors have used instead of an activity model to create a new product?