

COMMET 01319

Section I. Methodology

Reading the medical record. I.

Analysis of physicians' ways of reading the medical record

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Physicians were interviewed about their routines in everyday use of the medical record. From the interviews, we conclude that the medical record is a well functioning working instrument for the experienced physician. Using the medical record as a basis for decision making involves interpretation of format, layout and other textural features of the type-written data. Interpretation of these features provides effective guidance in the process of searching, reading and assessing the relevance of different items of information in the record. It seems that this is a skill which is an integrated part of diagnostic expertise. This skill plays an important role in decision making based on the large amount of information about a patient, which is exhibited to the reader in the medical record. This finding has implications for the design of user interfaces for reading computerized medical records.

Medical record; Computerization; Human–computer interface

1. Introduction

The computerized medical record as a central part of a hospital information system has been a great aim for more than 20 years. The realization of such a system seems very difficult to achieve [1]. For success, one necessary piece of the puzzle is the human–computer interface. Van Bommel regards this as one of the most important challenges for medical informatics [2]. Propositions have been made for including decision support facilities in connection with a computerized medical record. The existence of such options does not change the need for an effective user interface for basic routine use.

The user interface is especially important for physicians if the medical record is to be read from a computer screen instead of from a sheet of paper, since the medical record is a substantial part of their basis for frequent decision making. Since reading is performed in situations where time is limited it is important that the retrieval of information from a computerized medical record is not more time-consuming than reading from a conventional paper record. There are however reasons to believe that this will be the case. First, it is a general finding that reading from a screen is substantially slower than reading from paper [3]; secondly, in an evaluation of computers in primary health care, where record-keeping was one of the functions, Fitter et al. concluded that “there is strong evidence that over the range of applications studied the computer did not save time” [4]. In this study, manual entry of data probably accounted for a great deal of the time consumed, but it still indicates that working with

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a computerized medical record may be much slower than working with a conventional paper record. The experiences from a modern medical record system in Finland showed that more time was really needed and more effort was expended [5]. Garrett et al. [6] found no difference in the time needed when working with a computerized record compared with a conventional one. In this study the computerized medical record was read from paper printouts and not from the screen. This indicates that it is not the computerized structure itself which accounts for slower reading but the human-computer interaction.

In the literature there are divergent opinions about the paper based medical record. Niinimäki describes it as "disorganized and inaccurate heaps of information where seeking an answer to a particular problem is slow work" [5].

Sandblad et al. [7] pointed out that it is important to evaluate computer systems with respect to the actual work situation involved. As an example the medical record is mentioned. "When medical records are normally (i.e. manually) used, this is done by a number of different and in many respects, very advanced manners. The medical record consists of a set of different documents in a specific order. The documents have different shapes and can be marked with different signs and colours in the margin. It is possible to overview several pages at the same time, and to very rapidly browse through a large number of pages. The medical record can in this way be seen as multi-dimensional, coded in terms of shapes, colours and pictures and structured but not strictly formalized. The speed an experienced user can achieve in 'zooming-in' the relevant parts is remarkable, and the amount of information covered by a glance is enormous." The authors conclude that in order to define effective user interfaces a detailed analysis of the activities performed in the work situations involved is necessary.

The aim of this study was to understand how the paper-based medical record is in fact used by physicians today, with the purpose of obtaining a base for the design of a user interface for reading the medical record from a computer screen.

The medical record most often refers to the

documents describing the medical history and treatment of a patient. It constitutes a part of a large documentation system, comprising routines and regulations for record keeping, storage and retrieval. The medical record serves several purposes, has got several categories of users, and has several phases in its life-cycle from its first establishment to final archiving. In this study our focus is *the medical record as a working instrument for a physician in the basic routine work in a hospital*.

The physician's task is complex. He listens to the description of symptoms, questions the patient, performs physical examinations, prescribes actions, treatments and medications. The communication between the physician and the patient is of course very important, as is the communication with other categories of health care staff. However, the main part of a physician's work is an intellectual effort comprising the evaluation of different hypotheses, estimation of probabilities, assessment of risks, decision making based on partially uncertain information, and planning of actions several steps ahead. Besides medical knowledge the physician needs to have intellectual skills and diagnostic expertise. Diagnostic expertise can be described as the ability to find relevant clues, to interpret clues in relation to the actual situation and an ability to choose effective test- and examination strategies. In this study our main concern is how the medical record is in fact used as an instrument for these activities.

2. Contents of the medical record

Today the medical record in Sweden most often consists of a bundle of papers, mostly in A4-size (210 × 297 mm). The bundle is often kept in a folder marked with the patient's name and date of birth. A standard for the contents and the structure is described in ref. [8]. This standard includes

- labels and keywords in the margin and not in the text
- standardized document forms
- a standardized document order.

Reason and history

Results of the physical examination

Assessment, diagnosis, actions decided

Note from visit

Short note

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AR
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Pat inkommer akut p g a feber.
Sommaren +84 op pat för acetomaga. i. Står sedan den p Cortone 25 mg i/2 tabl x 3.
Pat blev för fem dagar sedan förkyld med snuva och hosta samt feber. Fördubblade då Cortone-dosen till 25 mg i x 3. Inkommer nu då hon idag på morgnen uppmätt en temp på 38,5°. Vår för övrigt bra. Hostan har minskat, men snuvan kvarstår.
Gott och opåverkad. God muskeltkraft.
120/80.
Betringsfritt.
Regelbunden cym. frekvens 72/min. Inga blåsljud.
Auskultas helt u a.
SR 16 mm. HB 143. Vikt 5,7. Na 117. K 3,8. glukos 7,0 kretinin 67. Ulinstatus är u a.
Ful: Inga infiltrat. Status post thoracotomi.
58-årig kvinna som är op för acetomaga. Hade ett hypofyadrom. Kortisonbehandling. Inkommer nu: kut p g a fem dygns annings på temp omkring 38° och idag på morgnen temp 38,5°. Har fördubblat sin Cortone-dos själv.
Jag tar mätningar. Tar kontakt med dr Siv Eriksson, kor är bakpor. Vi bestämmat att pat skall stå kvar i den fördubblade Cortone-dosen. Inskäts på pc. Pat på hem. Uppmanas att återkomma om feber, ansträng eller astor. Hjälp- och svalgödlningar är tagna. Är sjukskrivt o m den 31/3 -85.
Pat har haft feber kring 38° och stått ungefär 1 x på dubbel Cortonepils 25 mg x 3 mlt i vanliga fall (25 mg x 3 mlt) nu i/2 för hur nedläggning ska ges. Rekommenderas minsta 20 mg hela tabl varannan dag om hon är feberfri. Återbesök planeras kring 10.

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Fig. 1. Notes in the medical record. Headings and subheadings (keywords) in the left margin.

Deviations from the standard form can be found, but in most clinical units the essential parts of the recommendations are followed. Some of the contents of the medical record are:

Notes from consultations (Fig. 1). For every outpatient consultation there is a text note describing the reason for the consultation, a case history, results of the physical examination, and finally a description of the assessment reached and the investigations decided upon and the treatment that the responsible physician has ordered. The text is mostly dictated into a machine by the physician and typed by a clerk. The notes are signed by the physicians. This type of notes is seldom more than one and a half pages of text and can be as short as a few lines.

Summaries of in-patient periods (Fig. 2). These describe in brief the patient's medical history, status on admission, actions taken, treatment given, status on release and assessments and actions planned.

Laboratory data lists (Fig. 3). Laboratory test results are recorded on special forms with one

row for each type of test and one column for each test occasion.

Referral forms (Fig. 4). These are special forms where a question including motivation is written

Medical history

Status on admission

Actions taken status on release assessment actions planned

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Fig. 2. Summary of an in-patient period.

For each *type* of document there is a specific order. The text notes are placed in chronological order so that the first note is on the first page. The notes are then subsequently written one after another so that a note can start anywhere on the page depending on where the last note ended. Referral forms, X-ray and other reports are typically sorted in reverse chronological order, so that the most recent referral form comes first.

3. Analysis of reading

Interviews were made with 7 physicians about their use of the medical record. The represented specialities were: general practition (2), cardiology (1), gynaecology (1), surgery (1), plastic

The documents in the medical record are arranged in a workplace specific order (Fig. 5). If the medical record is voluminous, a table of contents can be placed first in the bundle, otherwise the text notes describing consultations come first. This is the main part of the record and it describes the progress of the patient. Behind all text notes are bundles of laboratory lists, referral forms (specialist requests), X-ray referral forms, surgery reports, correspondence and other documents. The order of documents in the folder may vary from hospital to hospital. Within any one clinical unit the order is fixed.

Question from
treating physician

Answer from
specialist

Fig. 4. Referral form.

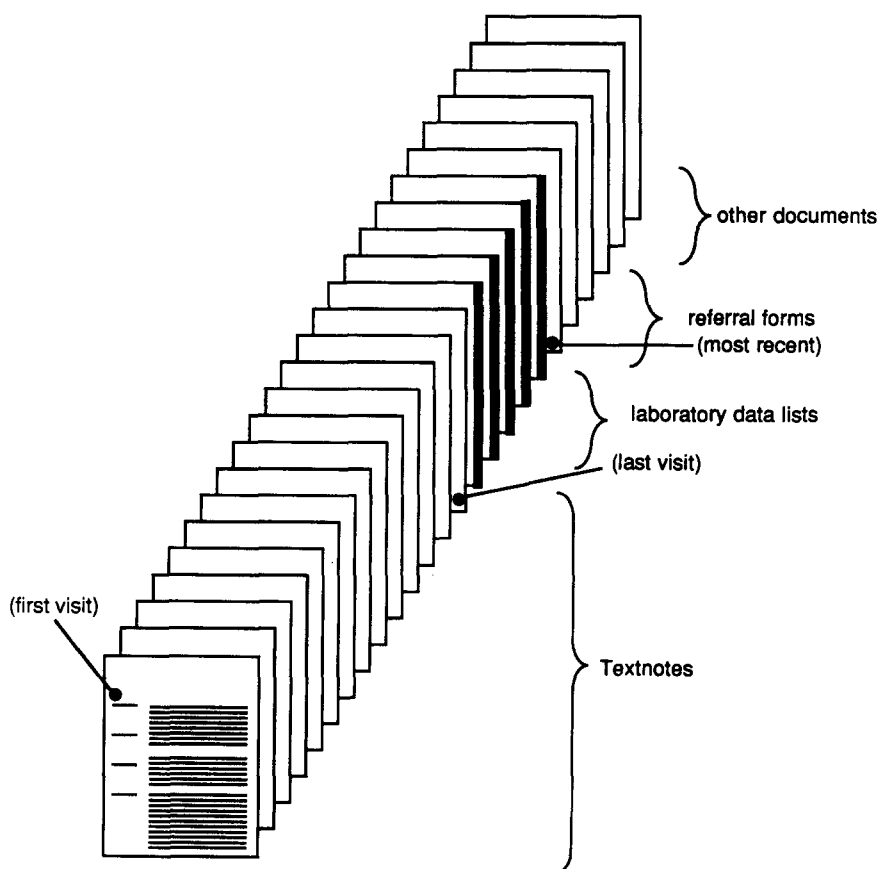


Fig. 5. The documents in the medical record are arranged in a workplace-specific order.

surgery (1), clinical physiology (1), and psychiatry (1). All interviewees had long experience of work (at least 5 years) and their experience ranged from university hospital clinics to small hospitals, primary care centres and private consultations. The total time for all the interviews of varying length were about 35 hours. Observations were made of one of the physicians (surgery) at work. The interviews were not structured but were focused on practical ways of handling the medical record which normally are considered too obvious to be mentioned. Questions were asked about how they read in different situations, e.g. how they navigated through the pages of text. In other words the focus of our interviews was the practical skill of reading rather than the use of information in an abstract sense.

After the interviews and observations, written descriptions of typical examples of use in different situations were made. These descriptions were presented to all those interviewed and modified until they agreed that the examples described a representative procedure of use.

3.2. Results

3.2.1. First time reading. Getting a fast overview and understanding of a case

There are a number of situations in which the physician's task is to get a fast overview and understand a case with the help of a sometimes rather extensive medical record. This is the case especially when reading for the first time, that is when the text has not been read before, and when the record concerns a patient who is un-

known. Examples of such situations are:

- preparation for a consultation with a new patient;
- “studying” a new patient on a ward;
- preparation before surgery;
- a specialist making judgements or assessing priorities of patients before admission.

In some of these decision making situations, the medical record is the only source of information.

There were individual differences between the physicians in their strategies of preparation before seeing an unknown patient. Some physicians preferred to get an unbiased opinion of a new patient whereas others always wanted to see what assessments by other physicians had been made during former consultations.

The strategy for reading also depended on the amount of information in the record. A very thin record (1–3 pages of text) might easily be read from beginning to end, whereas an extensive record must be dealt with according to some selection strategy. The thickness of the folder itself then acts as a clue to the choice of strategy.

As an example of a reading strategy, consider a physician preparing for a consultation with a new patient with the help of an extensive medical record. First of all, the physician will inform himself (or herself) of the reason for the consultation. In many cases this is described on a separate form attached to the medical record. A table of contents can be very useful not only for facilitating the localization of different types of documents but also for providing an overview of the content and thus a comprehensive description of the patient's history. Most often there is no table of contents. Summaries from hospitalization periods can provide an overview. The physician turns over pages in the medical record until he finds the most recent summary. If this is not good enough, or not clear enough, or incomplete, he will go to the next preceding summary until he finds one that gives an adequate overall description of the case. He will then look for the subsequent developments. He will turn over the pages in the record and glance through them. One

glance at a page is often enough. If he can see for instance the words “status OK”, under the heading “physical examination”, he may at once skip that note and proceed to the next one. If there is something that captures his interest, he will stop and read, but many pages are only glanced at. When a physician looks through the medical record in this rapid way, he captures much more information than would an untrained person. He is well acquainted with the structure and the layout and the expected contents under different headings. It seems that having an expectation of what to find under a certain heading makes for a faster interpretation of the text and recognition of deviations from the normal.

The physician will also look at the lab data. Abnormal results are informative, but so are normal ones. The fact that a test was performed and that it was normal at that point in time can be highly informative. The physician will also look quickly through the consultation requests, i.e., rapidly turn the pages, glancing at each request. If there are many requests he will not look at the oldest ones. The interviews showed that sometimes the age of the leaf was evident from its colour rather than from reading the typed date. Yellowing of the paper, and the typewriter font used, are examples of properties that can act as clues to the age of the document.

Different types of documents have different graphical layouts thus giving visual clues where to find them in the bundle. A lab data list is thus easily found, being for instance a paper with a red stripe along the right margin, located behind the typewritten text notes.

The medical record contains a time-scale in the sense that the notes from consultations are typed into the record one after another according to their temporal order. A new note can start with the date stamped in red. The distance between two red stamps, or rather the amount of text concerning one consultation, is thus an indication of the complexity of that consultation. For a patient with a chronic disease, regular consultations are often made for control purposes. Short distances between the red marks means that the progress of the patient was uneventful, whereas a long distance between two red stamps indicates

trouble. The red stamps were mentioned as very useful for keeping track of the different notes. The reader could “jump” from note to note by looking for the red stamps, i.e. skipping the text of one consultation and proceeding straight on to the next one.

The time available for preparation varies, but there was common agreement that time is limited and that a couple of minutes is not unusual but sometimes as little as 30 seconds will suffice.

3.2.2. *Re-reading. Triggering of a memory-picture*

If a patient is known, the physician has of course a memory picture of his or her situation, of the treatment given and planned. This memory picture contains much more information than anything that can actually be read from the medical record. The physicians interviewed agreed that these kind of memory pictures can be mobilized into the conscious memory at the mere sight of the medical record. With the help of associations the memory picture comes clearly to mind. More is remembered than what is actually written in the text.

Example: Physician 1 GP: “If it is my own patient I only have to give the last note a quick glance in order to make the memory picture come to my mind. Some figures I may have to look up but I do remember most of the content”.

Physician 2 GP: “when I speak to a patient over the telephone I feel handicapped without the medical record. The patient has to tell me her story all over again before I remember the whole picture. If I have the medical record in front of me the memory picture comes at once to my mind”.

The thickness of the record and the proportions of the different types of documents in it, as seen in the visible edge of the bundle, can trigger the memory-picture of a case. A patient with a chronic disease, for instance, can have a thick medical record with characteristic proportions of the different types of documents, e.g. many lab data lists with red stripes at the right margin or many X-ray referral forms with green stripes. In fact, some of the physicians stated that they recognized the patient and her situation just by seeing the folder itself from a distance.

When a physician has been treating the same patient for a long period of time, even a very

short note will be enough to bring the memory-picture to mind. Short notes of this kind can be a problem for another physician who takes over the responsibility for the patient.

The medical record is used to trigger the memory-picture in a number of situations. Examples of such situations are:

- During telephone contact
- In preparation for a consultation with a known patient
- In connection with a “round” on a ward
- Interpretation of a new test result.

3.2.3. *Searching for facts. Using the record as a dictionary*

In some situations the medical record is used as a dictionary of the medical history and treatment of the patient. The reason for reading is here to find an answer to a specific question. The physician may already know the case and wants to look up certain specific facts in the record. Examples of such situations are:

- (a) Prescription of drugs. The record is used to check the name of a drug used previously, if the patient has taken this drug before or if it has had any adverse effects.
- (b) During the physical examination. A finding can actualize the question: has this finding been noted before? This can require an immediate check.
- (c) During his or her conversation with the patient. The assessment regarding the treatment evolves during the consultation. The medical record is used to check what actions have already been taken and what were their results. The physicians interviewed differed in their opinion of whether it is acceptable or not to study the medical record in the presence of the patient. They agreed that the medical record acts as a support in questioning the patient. New information, as well as missing information, can determine the questions to be asked.
- (d) For instance, during dictation of a referral form or a summary the medical record is used as a basis. While handling the dictation apparatus with one hand, the other hand can be turning

pages back and forth in the medical record for looking up different pieces of information that will fit into the description being dictated. Sometimes longer pieces of text are read from the medical record. For this type of search for specific data, orientation in the record is essential. The fixed order of documents is important. The physician does not have to look through the whole medical record to state whether the patient has for instance a certain hereditary disease. He knows that if it was so, it would have been stated in a specific position. If it is not stated in that position, then he can be sure that it is not stated elsewhere.

If the fact that should be looked up has been seen before the location on the page is often used as a clue to find it again, e.g. *"I know I have seen it somewhere at the top of a page"*.

3.2.4. Problem solving

The medical record is used as a problem solving instrument in situations where decision-making is not straightforward. For instance when a diagnosis is not yet known, and the case is tricky. In this kind of situation the record is read in a special way. The goal of reading is neither to get an overview nor to find a specific fact but rather to test hypotheses, or evaluate strategies of action in the lights of the facts in the record. The physician may have a hypothesis of what is wrong and he turns pages in the medical record to look for support of that hypothesis. To look for support means that he will search actively for a specific fact that would be supportive, but it also means that he may stumble on other facts which happen to support or deny his hypothesis. These facts will call his attention as if they stood out from the pages, even if it was not the fact for which he was searching. His eyes may also be caught by something that gives him the idea of another hypothesis. He can then start to look for facts that support or contradict that new hypothesis.

In problem-solving the record is often read more than once. Information previously skimmed over very quickly during the first reading can be read carefully in the light of new knowledge. This new knowledge can be something the patient has

said, the result of a laboratory test, or simply that the diagnosis made on the first occasion turned out to be wrong.

This type of reading requires much navigation in the record. Pages are turned both forwards and backwards, which is equivalent to going forward or backward in time. Negating remarks like "no former abdominal pains" can be useful, but in a problem-solving situation the physician might still go further back in time and look for a mention of abdominal pains. A specialist referral mentioned in a note may cause the physician to find that referral form, read it, and then go back to where the referral form was mentioned.

In this type of reading it is not possible to say in advance what is relevant or not. Much of the text that is skimmed through in other types of reading is now read carefully. Fundamentally everything may be of importance.

3.3. Opinions about the medical record as a working instrument

Only a few problems concerning the medical record as a working instrument were mentioned in the interviews:

- disorder of documents severely affected the search-and-reading speed
- some complaints about too long text notes
- some complaints about too short text notes

In fact, all the physicians regarded the medical record as a well functioning instrument for their routine work. Positive remarks regarded the fine balance existing between structure and free text; enough structure to facilitate localization of specific facts; enough free text to enable description of the complex and unstructured reality. There is also a balance between the possibility to get a concentration of information in order to get a fast overview, as well as the possibility to read more thoroughly in a problem solving situation.

3.4. Analysis of the examples

From the interviews, we conclude that when time is limited, rather than selecting a few pages

and reading these carefully, many pages are scanned over in a short time. The conscious attention of the reader is of course directed to the contents of the text (or figures) in relation to the reader's knowledge about the case. However, the reader must also decide at every moment about what parts he should read. These decisions constitute the control of the reading process itself. It is probably performed automatically, without conscious attention.

The ways of use described, i.e. first time reading for overview, rereading for triggering of a memory picture, searching for facts and problem-solving, can all be analysed and described as an interchange between three levels of processing the text:

reading: all, or almost all words in a paragraph are read. The reader reads carefully word by word.

skimming: some, but not all words in a paragraph are read. The reader is skimming through the text letting his eyes wander along the pages.

skipping: no, or almost no words in a paragraph are read. The reader skips a paragraph or a whole page.

It seems that as the reader's eyes rapidly move along the text, dynamic decision making is performed. The decisions regard which level of processing that is suitable for each passage of text. That is whether paragraphs are worth reading slowly or not, or if paragraphs can be skipped completely or not.

Graphical features of the paragraphs can be perceived by the reader at all three levels. For instance, the position on a page, amount of text in a paragraph, the relation to the beginning or end of a note, or the typeface used. Especially interesting is that these features can be perceived, and interpreted, even if the reader skips a paragraph.

We can now describe typical *overview reading*. The reader has a goal, to get an overview and understanding of the case, but he has no target in the sense that he is looking for a specific fact. The reader is turning pages and skimming over the text. Certain words or sentences in the text attract attention which makes the reader switch

to more careful reading until something induces the reader to return to skimming, or to skip the rest of the paragraph. Expectations, conscious and subconscious, affect which words or phrases that attract attention. The absence of an expected word or a sentence can also attract attention. That is, a certain fact not being included in the text can attract attention. When the eye has been thus caught, reading is performed more carefully until the reader lets go of that part of the text and proceeds to scan pages and skim through text. Something induces the reader to make the decision to let go. It can be either that enough information has been captured from that passage or that it turns out to be less interesting than was anticipated.

Search, is when the reader is looking for a specific fact, a target. The reader skims through the text, and continues as long as the target is not found. When the target is found, reading is slower and more careful.

If the target fact has been seen before, remembrance of its localization on the page is often used as a clue for re-finding it. This is an effective way of limiting search space since all text can be skipped except for the text at the remembered position on each page. If the target is explicitly formulated, the reader can describe what he is looking for, e.g. the latest measured values of blood pressure.

Many times the target is more vague and cannot be explicitly formulated. For instance "has the patient had any abdominal symptoms before?" The target fact may have been seen before even if it is not explicitly formulated. "*I know I have seen something "abdominal" somewhere here*". Remembrance of localization can be used as a clue even in these cases.

In all kinds of target search the reader uses knowledge about structure, sorting order and textural layout to limit the search space as far as possible. "*If there is anything about abdominal pains it should be noted under the heading "history"*". This means that search-space is limited to the total amount of text of each note under the heading "history". It seems that perception of textural layout features is an effective means of limiting search-space.

Negating remarks like “No former abdominal pains” can be useful for chronological restriction of search-space. This remark means that there is no need to search further back in time.

The more structured the record and the more explicit the target, the more confident can the reader be that if the target fact is not in the limited search-space, then it is not in the rest. For vague targets in a record with a low degree of structuring there can be a need for searching the whole record to be able to state whether the target is there or not.

The *problem solving situation* can be described as an interchange between overview reading and search. The physician can have a hypothetic diagnosis and skim over pages in order to find support for this. Facts that speak either for or against the hypothesis attract attention. A fact can give new light to a hypothesis or give rise to the idea of a different hypothesis. This can bring about an active search for an explicit fact to confirm the new hypothesis.

In the situation of re-reading text, one glance at a paragraph can be enough to recall the content in sufficient detail to decide whether the paragraph is worth reading more carefully or not. Thus recognition of the paragraph acts as a trigger of the memory-picture of the contents.

Re-reading the text in the medical record in the light of new knowledge means that other words or sentences can attract attention compared with the first reading occasion. It also means that decision making regarding the right reading level for a paragraph can be different than that of the first reading occasion.

Several physicians pointed out that it is not only the facts mentioned in the record which are of interest but also *what is not in the record*. By seeing the complete record the physician can be aware of what is in the record as well as what is not present.

4. Discussion

All seven physicians interviewed informed us that they used the medical record in much the same way as described above, with only minor

deviations. Thus, we believe that this is a common way of using the record. However as the number of interviewed was limited, further verification is really necessary. For our purpose, which is to get a base for a human-computer interface design, this study must be considered reasonably representative.

The physicians interviewed considered the medical record to be a well functioning working instrument. There are other studies which have found more problems with the medical record than we did [5,9]. One of the reasons for this difference may be that problems regarding the availability of the medical record were not recorded in our study as we regard such problems as due to organizational malfunction. Another reason is that the medical record in Sweden most often can be described as semi-structured in the sense that almost every paragraph has a headline label and a keyword in the margin, whereas some problems with information retrieval from the medical record is reported to be due to the fact that keywords and indexes are dispersed into the text in some countries [9].

The problem with the overview of a large medical record as mentioned in ref. [5] was not supported by this study. Even a voluminous record could be handled rather easily. This was due to effective strategies for limitation of search space by perception of positional and textural features.

The exposure of large amounts of text to the reader is mentioned as a problem suitable to be solved by selected presentation by a computer. This means that the user has to actively request the parts to be displayed. In this study we found that during hypotheses testing the reader sometimes happened to notice a contradictory fact. This is probably beneficial to decision making as there is experimental evidence that people have a tendency to search for confirmative facts rather than falsifying ones in a situation of hypothesis testing [10].

Experimental reading research deals mainly with two types of reading, proof-reading and reading for comprehension [3]. Proof-reading is when a subject is reading a text and tries to localize spelling errors. Reading for comprehension is when a subject is reading a text and then

answers questions about the content of the text. In both types of reading, the text material is unfamiliar to the subjects. Most reading research thus deals with a situation where the reader is doing first-time reading of a short unfamiliar text, page by page, from left to right, and from top to bottom.

The results of our study show that this does not apply to physicians reading medical records. Rather we can see a spectrum of different ways of reading depending on the situation. We can also see that navigation is an integrated part of the reading task. Since guidelines for the design of human-computer interfaces for the reading of text on computer screens refer to the results of experimental reading research, mainly on subjects unfamiliar with the text, these may not be very relevant for the design of an interface for reading the medical record.

The medical record is very familiar in structure and content to an experienced physician. Like in a supermarket where you shop every day, the physician finds his way swiftly and easily through the record. The resemblance concerns exposure to an extensive set of items and lots of structure. The logical relations between items are reflected in physical relations like grouping, graphical layout and fixed positions. This structure is useful for orientation and navigation. Search for an explicit target is easy ("looking for tomatoes"), as well as for a less explicit target ("looking for a vegetable to go with the steak").

The human-computer interfaces of the systems we have seen so far more resemble an old-fashioned shop where you have to ask actively for every item. Exposure of one item at a time, presentation only on demand, and visually, a completely concealed structure in the sense that documents have no physical relation to each other and that textural variations are very few. The text presented on the screen gives very few perceptual cues that can be used for orientation. For instance every note is presented in the same position on the screen, and in characters of the same typeface. This kind of interface probably works well in a search for an explicit target, but problems can be expected in overview reading, problem-solving and in search for a less explicit target.

The results of our interview study thus give us the following *implications for design*:

- (a) Expose lots of information to the user, but with a high degree of positional and textural structure. Enable information items to attract the reader's attention even if it is not asked for.
- (b) Orientation and navigation is essential. Attention must be paid to graphical and textural features of the text presented. These should be controlled to indicate logical relations in order to enable effective limitation of search space. Make it possible for the user to use positional clues in re-reading and in search. It should be effortless to go both forwards and backwards and also to trace a referral form and then return to the page being read.
- (c) Let the user see the whole record in the sense that what is there is all there is. Thus make it possible to reflect upon what is not there. This means that the record should have no concealed levels.

A prototype of a human-computer interface designed for reading the medical record with the above options in mind has been designed at our laboratory [11].

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