Model of design rationale for outpatient medical care

Cleo Billa[1], Cláudia Barsottini[2], Jacques Wainer[1,2]

[1]Computing Institute – Universidade Estadual de Campinas (Unicamp)
Av. Albert Einstein, 1251, 13083-852, Campinas, SP, Brazil

[2]Department of Health Information Technology – Universidade Federal de São Paulo (Unifesp)
Rua Botucatu, 862, 04023-062, São Paulo, SP, Brazil

{cleo,wainer}@ic.unicamp.br, claudia@dis.epm.br

Abstract

In health care settings, interactions between providers are uncommon. This study shows that electronic medical records currently available do not favor interactive work and thus a model of design rationale applied to health care is proposed. As an extension to electronic medical records, this model intends to promote collaborative work among health care providers.

KEY WORDS: collaborative work practices, integration, patient record, design rationale.

1   Introduction

Health care usually creates the opportunity of patient attention by a multidisciplinary team of physicians, nurses, nutritionists, physical therapists, among others, and information collected by one provider can be useful to other team members for providing continuous care to patients (Berg, 1999a, 1999b; Ellis *et al.*, 1991).

Nowadays, growing costs of health procedures and increasing availability of information makes collaboration work sharing knowledge and skills not only desirable but required (Grimson *et al.,* 2000).

The introduction of electronic medical records was thought likely to bring greater fluidity of information which would facilitate collaboration among health providers, especially among physicians. However, some studies have pointed out medical records, either electronic or in print, need much further development to improve cooperation between providers while others have explored the limitations of electronic record use in multidisciplinary care: information reported is generally considerably inconsistent with the care really provided (Berg and Goorman, 1999; Hartswood *et al.,* 2003; Xiao, 2005).

These issues have been focus of study of both health information technology and technology researchers. Computer-supported cooperative work (CSCW) is a scientific interdisciplinary area that explores how group work can be supported by information and communication technologies to improve task performance. In health settings, it means specifically to understand how providers report and use patient's information collected during patient care. This understanding could provide medical practitioners better quality of care and make their work more effective and focused on patient's needs based on new collaborative technologies (Ellis *et al.*, 1991; Strauss, 1985).

In recent years, computing science, and particularly CSCW, has taken qualitative research approaches to explore and further understand how groups of people work collaboratively taking into account the development of systems appropriate to each group's social and technical background (Iqbal *et al.*, 2005; Macaulay *et al.*, 2000).

Ethnographic and case studies has been a resourceful instrument for CSCW researchers to identify requirements that could hardly be studied solely through observation of rules applied to an organization, area or group of people.

These studies can generally produce the following:
• Identification of non-documented information flows (i. e., the sequence information is conveyed, means used to convey it).
• Identification of actual division of work since it is dynamically determined, generally not complying with preestablished organization charts, without necessarily following a prescribed arrangement.
• Knowledge on the limitations of medical records, either in print or electronic as currently available, can be valuable for modeling electronic medical record projects intended to promote collaboration among their users.
In a collaborative work setting, it is crucial for human interaction and communication in general to be familiar with

everyone's job as well as to be concerned and responsible, which can make these settings, especially in health, more dynamic and reliable. These are relevant issues to be taken into consideration in the development of CSCW-based and delivered frameworks (Weerakkody and Ray, 2003).

The purpose of the present study was to identify social and organizational requirements of a group of medical practitioners focusing on the use of a computerized system for recording patient information and to construct a design rationale-based interface to promote collaborative work among them (Pratt *et al.*, 2004).

2 Relevance of research on medical collaboration

The present study intends to understand the nature of interactions between physicians caring for the same patient over a long period of time using as means of communication the patient's medical record and to describe how these providers obtain and use the recorded information in their care (Clarke *et al.*, 2001).

Additionally, the collaborative work can be tracked over time: a first physician provides care to a patient and records her/his information in the medical record. In the following visit, a second physician, based only on this patient's medical record, becomes up to date on the patient's condition and treatment status.

However, information flow can be restricted because patient's information may be stored at a different level of organization and be unavailable to providers of a given department, which hinders care management. This situation can rise from providers' inadequate perception of their colleagues' activities in different groups or departments. Restricted information flow and poor perception of other people's work create low interdependence and ineffective partnerships among health providers, a scenario that has been described by several authors in health organizations in the US and Europe (Pinelle and Gutuwion, 2006).

Yet health care, particularly long-term care of chronic or syndromic patients, is seemingly a remarkable example where physician cooperative work should be promoted. Patients with syndromic diseases usually have a set of signs and symptoms and more than one physician is required to provide care for all ensuing outcomes. Besides, one should bear in mind their disease course as they mostly have lifetime conditions.

In university care settings, where training is provided, practitioners' turnover is generally high. In services providing care for chronic patients, the same patient may be seen by several different providers over their lifetime and, in the light of this, collaboration between different specialty providers is desirable. But, in acute cases, inconsistent or missing medical information can prevent quick and accurate diagnosis and thus collaboration between physicians is necessary.

Two outpatient clinics in a large university hospital in the city of São Paulo, southeastern Brazil, were studied. The study was conducted in a highly complex public hospital where patients can be provided numerous services, from emergency care, regular visits in specialty outpatient clinics, and tests to hospital admission. Hospital services are public funded and thus its clientele consists largely of people with no private health insurance. Detailed information on the departments studied is described elsewhere (Barsottini and Wainer, 2005).

It should be stressed that, when exposed to information overload, each one has its own way to deal with it. Some people are able to process large amounts of concomitant information due to their maturity, skills and ability as well as their knowledge on a given subject. Information flow needs to be managed to prevent overwhelming people with information beyond their ability to process and assimilate it, though this ability is not easily measurable. To prevent information overload, there should be a balance between provision of information required and preservation of focus on work. Providing asynchronous, structured, filtered, grouped, concise, and customized information could be helpful to attain such balance (Kraut and Attewell, 1997). People should have an overall view to be able to select the pieces of information they are interested in and to obtain detailed information when required. Reducing information overload in communication can be achieved through storage of arguments used in decision making on a given treatment, for instance, and providing uncomplicated relevant information that will help those involved in the patient care to determine these decisions' relevance and background without having to go over the entire medical record (Gerosa *et al.*, 2001).

Understanding the limitations of medical records, either in print or electronic as currently available, can be valuable for modeling electronic medical record projects aimed at promoting cooperation among users (Atkinson, 1995).

3 Case study

A qualitative study was carried out with data collection, analysis and description of findings with a clear purpose of answering the research questions to support the development of a design rationale-based collaborative interface. Data was collected through field observation and physician interviews (Varjas *et al.*, 2005). Non-participative observation and non-structured interviews were conducted to reinforce perceptions these authors had while studying physicians' performance and use of medical records in their patients' care and chronic

situations of inadequate work collaboration through medical record use as well (MacLean *et al.*, 2002). Two outpatient clinics specialized in chronic diseases, General Neurology and Renal Lithiasis Outpatient Clinics, were studied.

Clinical neurology is a medical specialty that deals mostly with chronic and syndromic cases managed with regular visits when disease progression is assessed, medications are adjusted, symptoms are evaluated and treated and patients are referred to consultations with other specialties as needed. Proper patient care and decision making involve multidisciplinary, collective, and comprehensive discussions between health providers and much information is retained by the chief medical officer who consistently follows up all cases.

Nephrology, and in particular renal lithiasis subspecialty, is a specialty that cares for chronic patients requiring regular visits when disease progression is evaluated and medications are adjusted. Similarly to neurology, the chief medical officer discusses all cases and retains most patient information.

In both outpatient clinics, patients generally have large medical records due to their long-term disease but these records are incomplete as other specialties treating the same patient keep separate records. It should be noted that, as these specific services are provided by a university hospital, patients are likely to be seen by different physicians. Much information is retained by the chief medical officer who consistently follows up all cases and discusses them with resident doctors and providers from other departments in the hospital.

The study (Barsottini and Wainer, 2005) found several factors related to medical records that prevented collaboration over time:
- Use of inadequate language to describe signs and symptoms.
- Missing information on diagnostic hypotheses.
- Missing information on treatment and medications (doses, duration, starting and ending dates, symptom association).
- Inadequate information collection and presentation.

In addition, medical practice and professional experience markedly contrasts in different units, departments, hospitals and specialties (Lorenzi and Riley, 2002). Working conditions in different medical departments and specialties should also be taken into account as determinants affecting the level of collaboration among physicians.

4 Proposed model

It is here proposed the use of a design rationale-based model (or *DR model* for short) as an add-on to electronic medical records. The model is intended to facilitate collaborative work among physicians.

Design rationale has several definitions based on the background and approach employed (Moran and Carrol, 1996; Regli *et al.*, 2000; Shum and Hammond, 1994; Maclean *et al.,* 2002; Conklin and Begeman, 1987). According to Moran and Carrol (1996), design rationale is a set of logic reasons given to support the designed artifact. In the present study, patient records are the artifact and design rationale comprises logic reasons for supporting tests, diagnoses, and medications. In other words, it is knowledge on why a given action or decision was taken.

There are several different approaches to represent design rationale. Regli *et al.* (2000), described reasoning-based design rationale having a semi-formal graph as the main framework. In this graph, vertices represent components and its arches represent links. The most common representation frameworks of design rationale are IBIS, QOC, and DRL.

IBIS (Issue-Based Information System) was developed as a tool for discussions on a given subject (Conklin and Begeman, 1987). Through this approach, a problem is proposed, several solutions are suggested and arguments are given to each one of them. According to Shum and Hammond (1994), IBIS was the first definite representation for project reasoning. QOC (Question, Options, and Criteria) is a similar to IBIS but the latter focuses on capture of reasoning of a single project (Shum and Hammond, 1994). On the other hand, DRL (Decision Representation Language) is an extended approach to IBIS and QOC (Shum and Hammond,1994) proposed by Lee (1990).

The DR model is similar to IBIS and QOC but instead representing problems, solutions and arguments, it represents signs, symptoms, tests, diagnoses, and medications. For a more powerful model, comments, suggestions and reasoning can also be included.

The model is actually a flow chart where signs, symptoms, tests, diagnoses, and medications are represented by rectangles; comments, reasoning, and suggestions are represented by ellipses; and the links between all these pieces of information are represented by arrows. Although the relationship between information is not necessarily of cause and effect, arrows were employed as the authors believe they make these relations more easily understandable.

The interface allows the construction of a graphic representation of the medical visit information. For example, a patient comes with the following complaints: "headache causing neck pressure," "I've been thirsty for the last days," and "I've noticed I lost some weight in the last 5 days". In the general physical examination, the physician checks the patient's blood pressure, temperature and blood glucose. Information collected during care lead to the

diagnostic hypothesis of high blood pressure, high blood glucose, and a flu-like condition suspected of dengue. At the end of the visit, the physician discusses the diagnoses with the patient, prescribes medications, gives general advice, schedules a follow-up visit and the visit is complete.

The physician enters patient information, medical history, symptoms, tests, diagnosis, and treatment in the medical record. As mentioned before, there is no control on the format or content of information entered especially concerning reasoning on the decision made. Hence, a second health provider may examine this patient's medical records and wonder "why was this medicine prescribed?" or "based on what was this diagnosis made?". To answer these questions or to better understand provider's actions and decisions the proposed model comprises major information on the visit and allows it to be linked and/or justified. Figure 1 shows a graphic representation of the model generated by the system. It comprises all patient's symptoms, tests, diagnoses, and medications and, through this layout, health providers can present their reasoning by making links and justifying their actions, i. e., they should use the chart generated to link information and enter comments on their actions and decisions taken as needed.
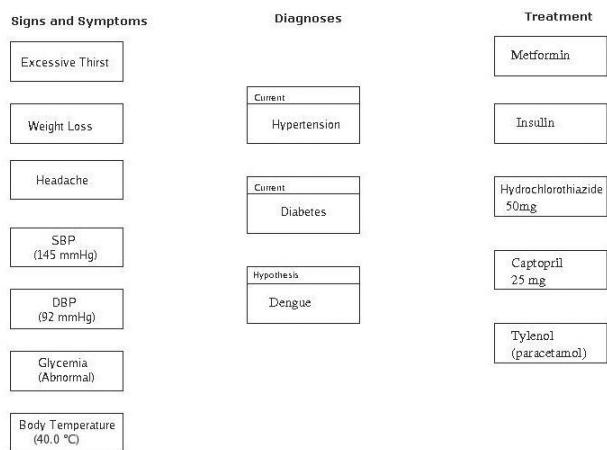

Figure 1. Flow chart generated by the system during a visit.

To report a relationship they just have to draw arrows linking two pieces of information that are directly related. For instance, in Figure 1, a provider can show the relationship between blood glucose test and the diagnosis of diabetes or she/he could link the drug captopril to hypertension. As the model's purpose is for health providers to convey their reasoning, these links have no restrictions at all. Providers are free to create any link and they could even create more than one link for the same information, e. g., the drug hydrochlorothiazide is also prescribed for hypertension and therefore two or more medicines can usually be associated to the same diagnosis.

An example of links is shown in Figure 2. It can be noted that symptoms excessive thirst and weight loss together with blood glucose test led to the diagnosis of diabetes and blood pressure measure led to the diagnosis of hypertension. Other symptoms such as headache and high fever led to suspected dengue. Figure 2 also shows the treatment intended for each drug prescribed and it can also be noted a direct link between a drug and a check (Tylenol for high fever).
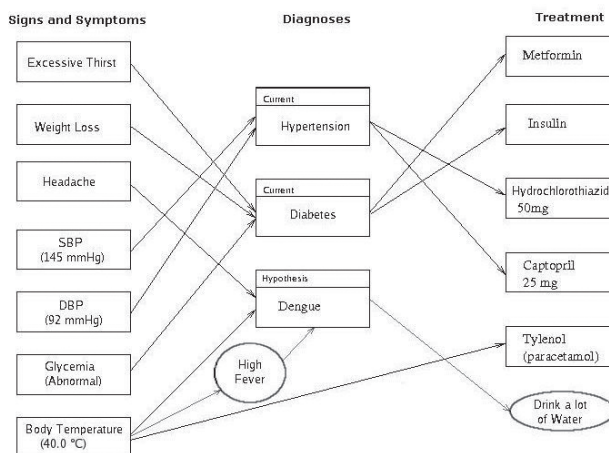

Figure 2. System–generated flow chart with links defined by the physician.

The model intends to clarify how a physician reached a given diagnosis or why a given medication was prescribed or even why a given test was requested. The more descriptive the model, the easier it will be to understand provider's reasoning during the visit. For that reason, it is also possible to enter comments and link them with any other information in the chart. Figure 2 shows the provider links temperature check with the comment "high fever" and the diagnosis of dengue as well showing her/his reasoning to reach a diagnosis. A second comment was also added: "Drink plenty of water," but in this case the provider tells only what was recommended to improve treatment. Entering comments can serve to any purpose, either to support a diagnosis or to simply provide additional information for treatment.

It is worth noting that information shown in the flow chart is not required to be from the current visit. For instance, a diagnosis made in prior visits can be included in the charts of following visits as long as it is relevant. This is required because some new decisions or actions are based on information from prior visits. For example, after the diagnosis of hypertension is confirmed, some medications can be added or discontinued in the following visits and in the physician's reasoning representation, these medications cannot be disconnected and should be linked to the diagnosis of hypertension.

In the model, all diagnoses and medications that are still ongoing should be incorporated whenever a new visit chart is generated. For example, after the first visit, a patient comes back complaining of loss of appetite, muscle pain and headache. The physician checks again the patient's blood pressure, temperature, and blood glucose. As hypertension and diabetes have already been diagnosed they are not required to be reentered in the database. However, the physician rules out dengue and tells the patient she/he has only a cold and decides to discontinue the medications metformin and hydrochlorothiazide and prescribes a new drug, propranolol. The chart is then automatically generated by the system for this new visit, as shown in Figure 3. In the new chart, information of the current visit has no links while information from prior visits has already some defined links. All symptoms and tests are information of the current visit and medications and diagnoses can be from prior visits.

Diagnoses and medications of prior visits are represented by dark rectangles to be differentiated from diagnoses and medications of the current visit. When a drug is discontinued or a diagnosis becomes old, they are represented by dotted-line rectangles and will no longer be included in the next visit chart.

Figure 3 displays a flow chart with the diagnoses of hypertension and diabetes from the prior visit while the diagnosis of cold was made in the current visit. It also shows that the suspected diagnosis of dengue was not confirmed. In addition, it tracks all medications prescribed: those prescribed in the prior visit are represented by a dark rectangle (insulin, captopril, and Tylenol), those discontinued are represented by a dotted-line rectangle (metformin and hydrochlorothiazide) and those prescribed in the current visit are represented by a fair rectangle. Based on new information available in the flow chart, health providers can define the links between new and old information. An example of these new links is shown in Figure 4.
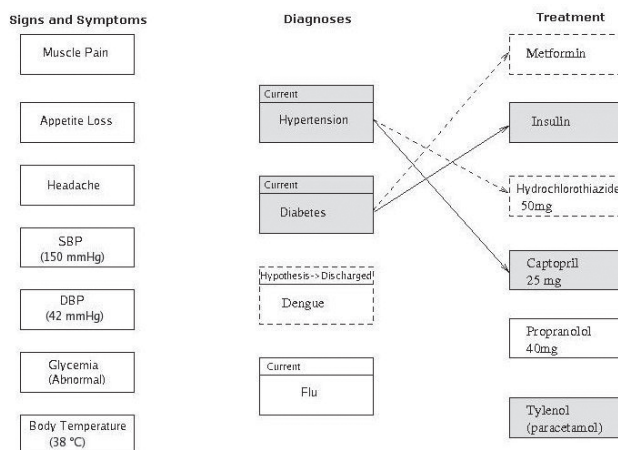

Figure 3. Flow chart generated in a follow–up visit.

In Figure 4, blood pressure is again linked to the diagnosis of hypertension and blood glucose test is associated to the diagnosis of diabetes. Other symptoms and tests are directly related to the diagnosis of cold and the new drug prescribed (propranolol) is linked to the treatment of hypertension.
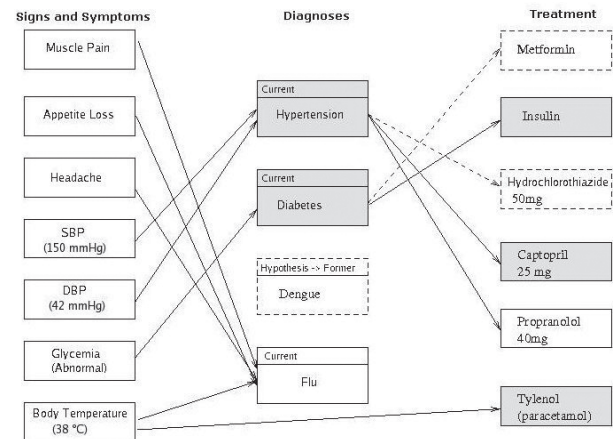

Figure 4. Flow chart of a follow–up visit with new links defined.

Although links have been created in this chart, there are still unclear elements in the provider's reasoning. For example, "why was the diagnosis of dengue replaced with the diagnosis of cold?" or "why was hydrochlorothiazide discontinued?". These are questions that only the physician who provided care to the patient can answer. However, some of them can be answered with a straightforward comment added to this visit's chart. Going back to the previous example, the provider enters her/his comments as shown in Figure 5.
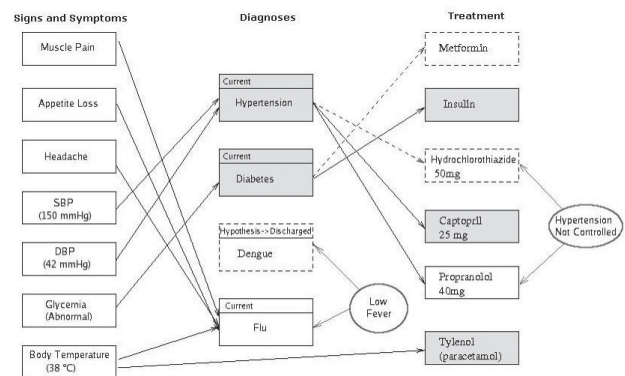

Figure 5. Flow chart with links and comments.

These comments indicate the provider replaced the diagnosis of dengue with a cold because the patient did not have high fever. And the hypertensive agent was replaced because the patient's hypertension was not well managed. To further clarify the model's working, let's

assume this same patient returns for a third visit. But now the patient does not have any complaints and reports she/he is feeling well. Even though, the provider checks the patient's blood pressure, body temperature, and blood glucose. She/he concludes the patient's cold is over but the diagnoses of hypertension and diabetes remain unchanged. Tylenol and captopril are discontinued.

Figure 6 displays the current visit's chart. Again, dark rectangles are information from prior visits, dotted-line rectangles represent old diagnoses or discontinued medications and fair rectangles contain information gathered in the current visit.
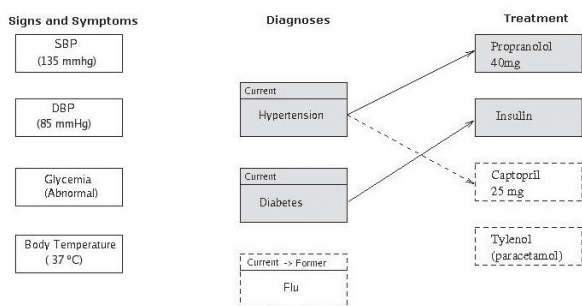
Figure 6. Flow chart generated in the third visit.

As for prior visits, the provider should link information to contextualize it into the patient's clinical presentation. Figure 7 shows blood pressure check was linked to the diagnosis of hypertension while blood glucose was linked to diabetes. The comments in the chart support the provider's actions: the diagnosis of cold is marked as old since the patient no longer have any symptoms and his/her temperature is normal. Also, it is explained why captopril was discontinued and propranolol was continued because it managed to treat hypertension, as indicated in the blood pressure check.
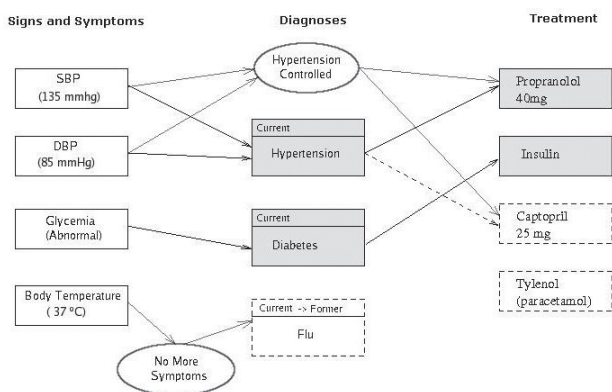
Figure 7. Flow chart of the third visit with links defined.

The example above illustrates that the use of design rationale in a medical setting can facilitate the understanding of actions and decisions taken by a health provider during a visit. The proposed model can represent this provider's reasoning.

5   Plans for model evaluation

The model described above has been implemented as a Java program. We discuss in this sections the plans for the evaluation of the model. It is our understanding that the model proposed presents to a physician a large set of innovations and modifications in his/her current work practices, and thus a careful evaluation must be planned.

The model proposes that the physician would enter the patient information as diagrams objects, something that physicians are not use to. The model also proposes that the physician would make explicit their diagnostic and treatment reasoning, again something most physicians are not use to, unless they your in teaching environments, and even in this condition, the explicitation of the reasoning is done after the fact and in verbal interactions, not written documents. On the other hand, there are many aspects to evaluate about the model:

1. Does the physician accept entering the data as diagram objects? Does this form of interaction increases or decreases the efficiency and the quality of the data entry activity?
2. Does implemented system has a usable or even pleasant user interface?
3. Will the physician make his medical reasoning explicit? If so, does the unlabeled direct link between the diagram objects (with the possibility of adding comments) rich enough to express the reasoning?
4. Does reading the diagram, instead of a traditional medical record increases the understanding of the care provided to the patient?

Given all these research goals, we decided to start the evaluation by the last question, whether the use of the model increases the understanding of the physicians reasons and actions in the patient's care - which we call the usefulness criterion. The other research questions are in some way dependent on this one: if the model does not increase understanding the is little point in discovering whether the model (as it is proposed) is rich enough to express the medical reasoning. In fact, if the model does not increase the understanding, maybe the solution would be to make it richer, and answer the third research question on the richer model. And unless one expects a significant gain in data entry efficiency, there is little point in pursuing the first two research questions, if the model is not useful for its intended goal.

In order to evaluate if the model usefulness we will carry a pilot test with physicians and 6th year medical students at UNIFESP outpatient clinic. A set of real patient records will be represented using the DR model - the data entry for each of these consultations will be done by the authors, with the help of a very experienced general practician who will make educated guesses on why the actions reported in the record were taken, and so provide us with a plausible recreation of the original physician's reasoning to be recorded in the DR model. If the specialist cannot justify the action, the whole patient record will be excluded from the experiment. Finally the specialist will elaborate questions regarding the diagnostics and treatment of the patients whose records were converted to the DR formalism.

The group of medical students and physicians will be randomly divided in the control and experimental groups. Both groups will participate in a lecture in which the DR model will be presented. The control group will receive the patient's records in the standard text format, and the experimental group will receive the records in the DR form. Both groups will have to answer the specialist's questions regarding the patient care. The answers will be blindly graded by the specialist. Standard non paired t-test will be used to evaluate if there is a significant difference between the two group's grades. Member of the experimental group will also be interviewed to relate their experiences and opinions regarding the use of the DR model.

If the experiment shows the usefulness of the model, we will then approach the second research question, on the usability of the user interface to the system. We feel that even if the model shows its usefulness, the changes it imposes on the physicians work practice are significant, that any difficulties, such as an unpleasant user interface, will hinder the evaluation of the first and third research questions. The system as it is currently implemented allows for two forms of data entry: the physicians drags the graphical objects into the DR diagram and link them with the arcs during the consultation, or he/she writes a semi-structured text with the signs and symptoms, tests, diagnostic hypothesis and treatments, and the system automatically extracts the graphical objects from the text and presents to the physician, which then create the arcs linking the objects (maybe after the visit!). We do not know yet which of these modes of interactions will be more acceptable to the physician, and the usability evaluation will provide us the answer.

6   Discussion

This paper presented a design rationale based model for the representation of a patient's medical record.

Our first goal is that the DR model will facilitate the later understanding of the patient's care by another physician. This is a weak form of collaboration, a collaboration through time, but it is common in design domains, in which a second group of designers must understand some of the reasons for the choices made by the first design team in order to continue or change the artifact.

In the health care domain, Barsottini and Wainer (2005) observed that the following factors play a role in preventing a better form of collaboration through time for physicians:

- Use of inadequate language to describe signs and symptoms.
- Missing information on diagnostic hypotheses.
- Missing information on treatment and medications (doses, duration, starting and ending dates, symptom association).
- Inadequate information collection and presentation.

The DR model attempts a technological solution to mitigate the last three problems. The model is a data collection and presentation tool. By allowing the physician to link diagnostics (or diagnostic hypothesis) with symptoms and tests, we hope it will be easier to express the diagnostic hypothesis - there is no need to write explanations why a particular diagnostic was assumed as a hypothesis and why it was dropped from consideration in a later visit. Similarly the linking of medications to diagnostics and to symptoms explain some of the reasons for their choices. By relating the diagram for one visit to the previous visit, as shown in Figures 3 to 7, the model allows the physician to explicitly say what is no longer true in the current visit, which hypothesis were dropped, which symptoms disappeared, and which medications changed. That provides direct information on the duration of the medications, and provides further information on why some medications changed during the treatment.

Even if the model proves useful, as defined above, and the physicians accept using it as a way of entering and representing the patient record, there are some other issues that may prevent the acceptance of the system, and the possibility of a larger scale experiment. One that we are aware and taking steps to solve is the legal value of the patient record. The patient record is a document that may be inspected by professional boards, in order to evaluate the physician competence, and by legal bodies, in order to evaluate the physician blame on some of his/her actions. And it is unlikely that a DR diagram will serve as such a legal document.

We are currently developing a text generation component to the system - a system that given the DR representation of a single visit, generates as text, the findings and actions executed in the visit. Such text can

be automatically generated at the end of each visit, it can be corrected and amended by the physician, who signs it as the "legal part" of the patient record, were as the DR model is kept as the "operational part" of the record. The text generator can produce text with different levels of information, one that only lists the findings and actions (the rectangles in the model) and one that explains the actions (using the arc information). Also, this system will be able to generate a summary of the patient's whole treatment, using the sequence of models. The text generator for a single visit is implemented, but the evaluation on the acceptability of the generated text will only be performed after the usefulness evaluation.

References

ATKINSON,P. 1995. *Medical Talk and Medical Work: The Liturgy of the Clinic.* London, Sage Publications, 176 p.

BARSOTTINI, C. and WAINER J. 2005. Patterns of Collaboration and Non-Collaboration Among Physicians. *In:* OF THE 11th INTERNATIONAL WORKSHOP ON GROUPWARE (CRIWG), 11, Porto de Galinhas, 2005. *Proceedings...* Porto de Galinhas, p. 248-254.

BERG, M. 1999a. Accumulating and Coordinating: Occasions for Information Technologies in Medical Work. *Computer Supported Cooperative Work (CSCW),* **8**(4):373-401.

BERG, M. 1999b. Patient care information systems and health care work: a sociotechnical approach. *International Journal of Medical Informatics,* **55**(2):87-101.

BERG, M. and GOORMAN, E. 1999.The Contextual Nature of Medical Information. *International Journal of Medical Informatics,* **56**(1):51-60.

CLARKE, K.; HARTSWOOD, M.; PROCTER, R.N. and ROUNCEFIELD, M. 2001. The Electronic Medical Record and Everyday Medical Work. *Health Informatics Journal,* **7**(3-4):168-170.

CONKLIN, J. and BEGEMAN, M.L. 1987. IBIS: A Hypertext Tool For Team Design Deliberation. *In*: HYPERTEXT '87: PROCEEDING OF THE ACM CONFERENCE ON HYPERTEXT, New York, ACM Press, p. 247–251.

ELLIS, C.A.; GIBBS, S.J. and REIN, G.L. 1991. Groupware: Some Issues and Experiences. *Communications of the ACM*, **34**(1):38-58.

GEROSA, M.A.; FUKS, H. and LUCENA, C.J.P. 2001. Use of Categorization and Structuring of Messages in Order to Organize the Discussion and Reduce Information Overload in Asynchronous Textual Communication Tools. *In:* INTERNATIONAL WORKSHOP ON GROUPWARE - CRIWG, 7, Darmstadt (Germany), 2001. *Proceedings...* IEEE Computer Society, USA, p. 136-141.

GRIMSON, J.; GRIMSON, W. and HASSELBRING, W. 2000. The SI challenge in health care. *Communication of the ACM*, **43**(6):48-55.

HARTSWOOD, M.; PROCTER, R.; ROUNCEFIELD, M. and SLA-

CK, R. 2003. Making a Case in Medical Work: Implications for the Electronic Medical Record. *Computer Supported Cooperative Work (CSCW),* **12**(3):241-266.

IQBAL, R.; JAMES, A. and GATWARD, R. 2005, Designing With Ethnography: An Integrative Approach to CSCW Design. *Advanced Engineering Informatics,* **19**(2):81-92.

KRAUT, R.E. and ATTEWELL, P. 1997. Media Use in Global Corporation: Eletronic Mail and Organizational Knowledge. *In:* S. KIESLER (eds.), *Culture of the Internet.* Mahwah, New Jersey, Lawrence Erlbaum Associates Publishers, p. 323-342.

LORENZI, N.M. and RILEY, R.T. 2002. Organizational Impact of Health Information Systems in Healthcare. *Studies in Health Technology and Informatics,* **65**:396-406.

LEE, J. 1990. Sibyl: A Tool for Managing Group Design Rationale. *In:* 1990 ACM CONFERENCE ON COMPUTER-SUPPORTED COOPERATIVE WORK, Los Angeles, 1990. *Proceedings...* Los Angeles, p. 79–92.

MACAULAY, C.; BENYON, D. and CRERAR, A. 2000. Ethnography, Theory and Systems Design: From Intuition to Insight. *International Journal of Human-Computer Studies*, **53**(1):35-60.

MACLEAN, A., YOUNG, R. and MORAN, T. 2002. Design rationale: The argument behind the artifact. *In:* THE SIGCHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS: WINGS FOR THE MIND, Minneapolis, 2002**.** *Proceedings...* Minneapolis, p. 247-252.

MORAN, T.P. and CARROL, J.M. 1996. Overview of Design Rationale. *In:* T.P. MORAN and J.M. CARROL (eds.), *Design Rationale: Concepts, Techniques, and Use.* Mahwah, New Jersey. Lawrence Erlbaum Associates Publishers, p. 1-19.

PINELLE, D. and GUTWIN, C. 2006. Loose Coupling and Healthcare Organizations. *Computer Supported Cooperative Work,* **15**(5):537-572.

PRATT, W.; REDDY, M.C.; MCDONALD, D.W.; TARCZY-HORNOCH, P. and GENNARI, J. H. 2004. Incorporating Ideas From Computer-Supported Cooperative Work. *Journal of Biomedical Informatics,* **37**(2):128-137.

REGLI, W.; HU, X.; ATWOOD, M. and SUN, W. 2000. A survey of design rationale systems: approaches, representation, capture and retrieval. *Engineering With Computers,* **16**(3-4):209-235.

SHUM, S.B. and HAMMOND, N. 1994. Argumentation-based design rationale: What use at What cost? *International Journal of Human-Computer Studies,* **40**(4):603–652.

STRAUSS, A.L. 1985. *Social organization of medical work.* Chicago, Transaction Publishers, 310 p.

VARJAS, K.; NASTASI, B.K.; BERNSTEIN MOORE, R. and JAYASENA, A. 2005. Using ethnographic methods for development of culture-specific interventions. *Journal of School Psychology,* **43**(3):241-258.

WEERAKKODY, G. and RAY, P. 2003. CSCW-based system development methodology for health-care information systems. *Telemedicine Journal and e-Health*, **9**(3):273-282.

XIAO, Y. 2005. Artifacts and collaborative work in healthcare: methodological, theoretical, and technological implications of the tangible. *Journal of Biomedical Informatics,* **38**(1):26-33.