Learning Clinical Reasoning with a Dynamic Patient Simulation Program

Margret L.G. Alers[1], Peter M. Bloemendaal[3], Sylvia Eggermont[3], Victor H.J. Langeveld[1], Lambert G. Poels[1] and Pieter F. de Vries Robbé[2]

[1] CIO-group and [2] Dept. of Medical Informatics, University Medical Centre Nijmegen, The Netherlands
[3] Dept. of Surgery, Leiden University Medical Centre, The Netherlands

Abstract

During clinical reasoning a physician makes explicit the arguments for any further diagnostic or therapeutic action to be taken. The Dynamic Patient Simulator® program simulates the patient and the effects of treatment.
In a new program we integrated essential elements of clinical reasoning with this existing simulation program. In this paper we outline the difficulties we came across and the achievements of our work.

Introduction

The University Medical Centres in the Netherlands follow the general objectives as described in the Blueprint 2001 (1). This blueprint describes the elements a training program of physicians should contain. One of these elements is training of clinical reasoning, underlining the process of problem-oriented thinking and defining problems that any physician must be able to handle.
In 2003 a collaborative study was started by four Dutch universities to incorporate the Nijmegen approach of Clinical Problem Analysis (CPA) (2) into the Dynamic Patient Simulator® program (DPS) (3) and to produce CPA-DPS-cases.
This study should lead to an e-learning environment to train explicit clinical decision-making.

Dynamic Patient Simulator®

Fig. 1 An impression of DPS

The Leiden University Medical Centre started developing a computer-based simulation program, the Dynamic Patient Simulator® (DPS) [3] in 1996. Through the use of DPS, medical students can practice medicine on a virtual patient. During a simulation, students autonomously assess the state of the patient by taking medical history and performing physical examination and additional research, thus gathering enough information to make a (differential) diagnosis and start therapy. Students are held responsible for the consequences of their actions: starting an inappropriate therapy may deteriorate the patient’s condition or induce medical complications. The state of the patient and all actions performed by the student, are logged into the DPS database. DPS provides personal feedback, depending on the student’s preceding actions and gives a final score at the end of a simulation. The dynamic help system is subject to the actual state of the patient and the actions already taken by the student. DPS has been developed in Microsoft Visual Basic and uses a Microsoft Access database. DPS supports all kinds of multimedia. By integrating the Microsoft Internet Explorer in its interface, DPS can link directly to all kinds of information.

Clinical Problem Analysis

At the University Medical Centre Nijmegen (UMCN), the approach, called Clinical Problem Analysis (CPA) [2] has been developed. This CPA is used to teach medical students a systematic approach to solve clinical problems. Students at their 3rd and 4th year of medical education at UMCN, attend courses on clinical reasoning using the CPA method. Students have to solve several patient cases presented in a paper format. In paper patient cases, students are asked to identify and cluster the triggering data into a set of clinical problems, and to associate these with differential diagnostic hypotheses, subsequently followed by a proposal for further examination, therapy and monitoring the disease. Relevant information is collected from the appearance of the patient, his or her background, medical history, present illness, and physical examination, including already available test results. In this way a list of activating findings is constructed. Several diseases can explain these activating findings. The medical student actively groups activating findings and chooses a medical term to be assigned as a label to each problem, explaining a group of activating findings. The student constructs a differential diagnosis for each current patient problem. The relevant set of hypotheses will be indicated. Students create an action plan in which further examination is prescribed. Every diagnostic action should always be explicitly connected to at least one hypothesis. Therapy will aim to remove or treat the cause of a patient’s problem.

Clinical Problem Analysis with the Dynamic Patient Simulator®

Integrating CPA with DPS provides an interactive presentation to replace the paper patient cases. Furthermore this enables us to document the student’s decision process for later analysis. The system continuously monitors the patient’s condition and the student's decisions. The program evaluates the student’s performance.
To judge the process of clinical reasoning during a simulation, to every patient case a knowledge base (problem tree) is added. This problem tree serves as a basis for

generic comments on the clinical reasoning steps made by the student. Therefore the comments are no longer dependent on the individual teacher’s view.

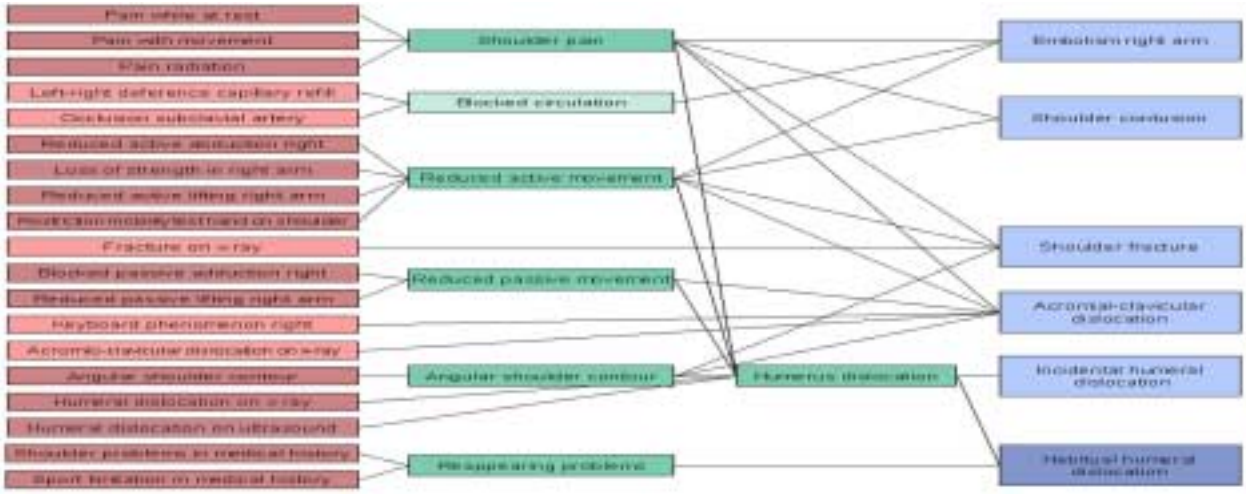

Fig. 2 Design of the problem tree.

The problem tree contains the activating findings that are present in the case, but also the normal findings, that could exclude other likely hypotheses. Furthermore it contains all relevant groupings and hypotheses.
In the DPS interface (Fig. 1), the left side is used to give input to the program, and on the right side, actions undertaken by the student can be viewed.
The first step in counselling every patient, is asking the most obvious questions from the medical history and performing basic physical examination of the body. At any moment the student is ready to start with the clinical reasoning, the student opens this feature by clicking the button. The core elements of Clinical Problem Analysis are to select the activating findings from a patient record, group them into problems and construct hypotheses. Linked to these hypotheses the student has to create an action plan. This process iterates until one or more hypotheses are proven to be the diagnosis and a correct therapy could be given. The program leads the student through this process.
The clinical reasoning tool uses only all the findings the student has gathered from the patient so far. The student should decide which item from the history or examination contains an activating finding. These activating findings are the building stones for the students’ own problem tree. The next step is to group these activating findings to more general problems, chosen from a list, offered by the program.
After constructing a list of problems, the student should make up a list of possible diagnostic hypotheses that can explain one or more problems. The student can request the best tests to discriminate between these likely hypotheses in the patient simulator. With the outcome of the tests the student can rule out hypotheses. Thereafter the student can administer the appropriate therapy.
At the result-side of the DPS interface, the student can see his progress on the process of CPA. When students have finished a case they can compare their own problem tree with the one the expert has made.
Because of the dynamic nature of the patient simulations we came across an extra dimension to CPA. In contrast to a static paper presentation of a patient's record, the

student can influence the patient’s condition during a simulation and thus the CPA process also changes.

Conclusions

In the past year we have succeeded to integrate the paper based CPA method of University Medical Centre Nijmegen with the DPS program developed by the Leiden University Medical Centre. As a result of this, the CPA method is enhanced to a more dynamic level.

Acknowledgments

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Correspondence to

Drs. Margret L.G. Alers
241 CIO-group UMCN
Geert Grooteplein 21 Noord
P.O. box 9101
6500 HB Nijmegen, The Netherlands
T +31 (0)24 3614286 or 3610762
F +31 (0)24 3610209
M.Alers@cio.umcn.nl

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Web-sites

- http://www.cio.umcn.nl/
  Click the DPS button to find information about Clinical Problem Analysis with DPS
- http://www.lumc.nl/DPS/
  This is the website of the developers of the Dynamic Patient Simulator®