RHEUMexpert: Medical Documentation and Diagnostic Decision Support in Rheumatology for the General Practicioner

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Background

The Austrian Society for Rheumatology (Univ.-Doz. Dr. F. Singer and Univ.-Prof. Dr. G. Kolarz) developed a consensus paper for a systematized documentation of signs and findings in rheumatic diseases that offers a basic guideline for general practicioners [1].

Objective

The goal of this project was to adopt the representations of the concensus paper to an easy-to-handle computer program for an electronic documentation of medical patient data. An integration of the software in existing computer environments should be feasible and a basic differential diagnosis support should be offered.

Material and Methods

The software consists of five data input screens (administrative patient data, history of illness, clinical data, laboratory exams, and X-ray findings) and an output screen with proposals of differential diagnoses. (Fig. 1) The differential diagnosis spectrum that is covered by the underlying medical knowledge base comprises the following major groups of rheumatologic diseases:

- back pain due to mechanical trauma,
- inflammatory diseases of the spine,
- diseases of the spine due to metabolic disorders,
- inflammatory joint diseases,
- metabolic joint diseases,
- degenerative joint diseases, and
- rheumatologic soft tissue diseases.

The knowledge base of RHEUMexpert comprises 350 findings, signs, and lab tests and 20 rheumatological diseases. The "raw" findings are converted into 71 higher-level medical concepts by 37 partly simple, partly complex rules (data-to-symbol conversion). The relationship between signs and diseases are specified by certainty factors, that either represent a positive or negative relationship. The inference algorithm is based on these certainty factors and a specifically designed gradient method. As a result, a number of diagnostic hypotheses (with a maximum of three diagnoses) are presented. In distinct cases, a further differential diagnosis support with more specific sub-diagnoses such as suspicion of rheumatoid arthritis and psoriatic arthropathy is provided. RHEUMexpert's integrated database allows a persistent storage of patient data. Interfaces for data export and import support data transfer to and from other programs. In addition, the system contains an international classification scheme of rheumatological diseases.

Results

In an evaluation study 75 patients were tested and the overall accuracy of the top-level diagnostic hypothesis generated by the system was 91% [2]. However, sensitivity and specificity vary considerably among the various diagnostic groups. As an example, the study showed that the sensitivity of well-defined disorders (e.g., rheumatoid arthritis) reaches almost 100%, whereas it is as low as 50% in some other diseases (e.g., gout) whose characteristic findings and symptoms are suppressed by treatment (drug medication) in many cases.
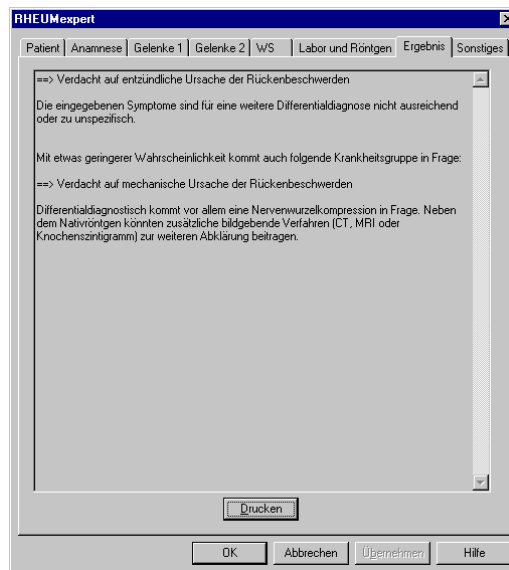

Fig. 1: RHEUMexpert-I data analysis screen (in German)

Technical specification

RHEUMexpert was implemented in C++ and primarily designed for Windows95/NT. Currently a German version is available. In the course of a running master thesis project the program is re-implemented using Java and the object-oriented medical expert system framework MedFrame to allow a Web-based distribution and access of the system [3].

Conclusion

Our results showed that a computer-based documentation of rheumatic diseases facilitates the systematized and standardized documentation of patient data. However, a few modifications of the knowledge base as well as the knowledge representation formalisms (i.e., to cope with the problems that are related with a concurrent therapy) are necessary. These modifications will be implemented in the next release (RHEUMexpert-II).

References

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