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Clinical Similarities: an Innovative Approach for Supporting Medical Decisions

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Abstract and Objective

Taking decisions in the medical domain is a very complex task. The context is strongly affected by uncertainty and the possible undesired side effects of the treatments have to be carefully considered. Currently, these decisions are based on the physician's own experience and the evidences of the published literature, according, when available, with the philosophy of Evidence Based Medicine. The main issues of this approach are that the own experience can be different, and the results in the literature are sometimes contrasting.

For helping physicians while taking medical decisions, we are proposing an innovative approach based on the idea of the clinical similarity. Given a set of clinical variables, the proposed approach selects patients that are similar, presenting to the physician the respective decisions taken and the corresponding clinical effects.

Keywords:

Clinical Similarity, Knowledge Representation, Machine Learning.

Introduction

The current way adopted by physicians for taking medical decisions, according with the philosophy of Evidence Based Medicine, is by relying on their own experience and the literature. But own experience may differ between specialists and the literature is not always conclusive in giving clear diagnostic and/or clinical indications. Moreover, techniques that have shown good results on some populations, can have different outcome on a completely different one [1]. It would then be useful to have access to the experience stored in Electronic Medical Records (EMR) for searching clinical cases similar to the one under observation and related to the considered population. A software agent, able to help the physicians in hard process of taking decisions, should face the critique task of modeling the concept of Clinical Similarity. It should be able to propose patients that are similar to the considered one. The proposed list must have a very specific property. A physician, while analyzing it, should immediately feel that the proposed patients are strictly related with the given one, even if he does not know how they have been selected.

In this paper we are proposing an innovative approach for supporting medical decisions, based on the idea of clinical similarities. Given a reference patient and a database of past patients, the proposed approach is able to generate the list of patients similar to the reference one.

Methods

We collected 407 clinical cases of patients treated for prostate carcinoma from the EMR of the Radiotherapy Department of the Brescia City Hospital. For each patient we considered four clinical variables: *Age*, *PSA*, *T stage* and *Gleason Score*. From the available database, we selected 20 clinical cases. We obtained a benchmark “perfect” list for each case by tens of questionnaires compiled by Radiation Oncologists. In this list the patients are ordered by their similarity to the reference one. For the automatic selection of similar patients, we tested different approaches; three based on well known machine learning techniques and one based on local search technique for tuning weights in a minimum Euclidean distance approach. The lists generated by the different approaches have then been compared with the “perfect” lists. The local search approach has shown the best performance, in terms of mean errors. In this particular *scenario*, it considered as very informative the *T stage* and the *Gleason Score* variables.

Conclusions

For helping physicians taking medical decisions, in this paper we introduced an innovative approach based on the idea of clinical similarities. Given a new patient and his clinical description, an automatic tool will present to the physician a list of similar patients, extracted from existing EMR, showing their treatments and the corresponding clinical outcome.

The achieved results show that the selected approaches, and especially the local search one, are able to generate good quality lists. The resulting lists have been then showed to the radiation oncologists of the Brescia City Hospital, that showed to have good feeling with them.

We are planning to extend the proposed approach in several directions, in particular: a generalization of the approach for handling different patient spaces than prostate carcinoma ones, and a work on a interface for presenting the ordered lists of similar patients and corresponding clinical outcomes.

References

- [1] Regnier-Coudert O, McCall J, Lothian R, Lam T, McClinton S, N'dow J. Machine learning for improved pathological staging of prostate cancer: a performance comparison on a range of classifiers. *Artificial Intelligence in Medicine*, 55(1):25-35, 2012.