Chapter 11
Telederm:
A Web-Based Decision Support System for Medical Practitioners

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ABSTRACT

In this chapter we describe a web-based decision support system called Telederm that has been developed with the aim of helping general practitioners diagnose skin ailments from a knowledge base while allowing incremental updates of the knowledge base as cases occur. We outline the two major challenges in developing the Telederm system: developing a general practitioner query process that is easily accessible and building knowledge validation in a case-based reasoning system. We provide a detailed description of our approaches to address these problems which involve the use of artificial intelligence classification and reasoning techniques. The system was deployed in a large scale trial in the Eastern Goldfields of Western Australia and we present the results and feedback obtained from an evaluation by the general practitioners involved.

INTRODUCTION

The past two and a half decades have seen a significant increase in the use of Artificial Intelligence (AI) methods to enhance the provision of medical services such as expert systems. More recently, research has focused on developing medical decision support systems to meet the needs of General Practitioners (GPs) in rural and remote areas, in order to reduce the number of patient referrals and the travel costs for patients. The research has been inspired by advances in telecommunication technology that has allowed the establishment of telemedicine services for the delivery of health care and the exchange health care information over the Internet (Perednia & Allen, 1995; Wootton & Craig, 1999). This can significantly benefit rural and remote patients, because without the availability of telemedicine, they

must travel large distances to visit a city-based specialist or consultant, which can be expensive, time consuming and inconvenient.

This chapter focuses on Telederm, a teledermatology system developed in cooperation with experts in the dermatology field to assist GPs with their decision making processes, and on the challenges involved in developing a decision support system that can be used by GPs with little computing knowledge. Dermatological complaints such as rashes are an important part of a GPs case load as 15% or so of patients suffer from skin problems. It is also well suited to a telemedicine approach because of the reliance of the diagnosis on historic data about the patient and images of the skin, both of which can be easily stored and transmitted over the Internet. It can benefit from AI because of the potential for interpretation of the historic data and the images. To our knowledge there have been no other attempts to incorporate AI techniques in order to provide automated decision support to GPs in analyzing patients with dermatological conditions. There are systems available that aid the diagnosis process, such as Dermis and Dermatlas, but these are mainly repositories of images and other information about dermatological complaints using relatively simple search methods.

In our research we have identified three major challenges in developing medical decision support systems. The first challenge is the need to shorten the length of the query process, and thus reduce the time required to reach a diagnosis. Medical practitioners can be reluctant to use such systems because of time constraints (Liaw & Schattner, 2003). The second challenge concerns the disparity between the types of questions asked by medical practitioners and those asked by decision support systems. This concerns the presentation of questions that closely model GP-patient interaction during traditional face-to-face consultations. For example, a decision tree classifier generates a number of separate yes/no questions as it homes in on the solution, and it is important to convert

these into the more user-friendly questions commonly used during traditional consultations. The third challenge concerns the dependency of the diagnostic performance on the quality of the cases stored in the knowledge base. For example, it is usual in a Case Based Reasoning system (CBR) for new cases to be added incrementally without checking the consistency of the knowledge base. However, in medical decision support systems where the correct decision is critical, updating (without supervision) can lead to significant problems including misclassification that may result in incorrect diagnoses.

The overall objective of our research has been to build web-based tools to enhance the quality of healthcare in rural and remote areas using information and communication technologies (ICT) technologies by developing a decision support system that is usable by GPs in the real world. The specific objectives of this research were threefold:

1. The investigation into the establishment of a web-based diagnostic system to provide dermatological services to rural and remote GPs, in order to reduce the number of patient referrals to city-based consultants and hence associated travel and other costs for patients;

2. The investigation and development of methods to assist GPs, who may not be familiar with aspects of complex computer based reasoning, in diagnosing patients with dermatological problems;

3. The development of techniques that aid dermatology consultants in validating the knowledge in the CBR system, and interactively supervise the knowledge updating process. This includes techniques to aid the consultant in dealing with electronic referrals from the GPs for those cases they cannot diagnose with the Telederm system.

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