CRITIQUING AS A MODALITY FOR COMPUTER ADVICE IN MEDICAL MANAGEMENT AND WORK-UP

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1. Introduction

The question of how best to adapt computer advice to clinical practice is especially important in a domain as complex and sensitive as medicine. The traditional approach has been to design systems which in some sense simulate a physician's decision-making and attempt to formulate similar conclusions. A recent study [1] suggests, however, that no matter how good such a system's advice is, its clinical value will be greatly diminished if it is not able to explain and justify its conclusions and recommendations to its user.

Indeed, several projects have worked to incorporate an explanation capability into their systems. [2, 3] An explanation capability allows a user to inquire why the system is pursuing a certain line of questioning, and why certain conclusions and recommendations are made. The goal is to help make the computer's logical processes transparent, so that the user can evaluate the advice he is given.

An explanation capability allows the system's advice to be adapted to the particular questions and concerns of the physician, using the computer's recommendations as a starting point.

A much more direct way to adapt the computer's analysis to the user's thinking, however, is to use a different modality for advice: a critiquing modality. Here, instead of initially telling the physician what to do, the system first asks what approach he is contemplating, and then critiques that plan. This mode of advice immediately focuses the system's analysis around the particular concerns of the physician in a very natural and direct way.

This approach ("Medical Plan-Analysis" by computer) is implemented in several different systems, and shows promise as a modality for computer advice in both medical management and work-up.

2. Critiquing Medical Management

In playing a game such as checkers or chess, there are always in theory "best moves" available at every point in the game. In a domain like medical management, however, there are usually several management alternatives at any point, and seldom is one the "best" in any absolute sense. The choice a physician makes is often very subjective, based on his practice preferences and his subjective evaluation of the risks that exist in the particular patient being treated.

In so subjective a domain, the critiquing approach to advice-giving is especially appropriate. This approach is currently being explored in several quite different areas of medical management:

1. The ATTENDING system [4] is designed to critique anesthetic management. In anesthesia, each underlying medical problem (e.g., asthma, coronary artery disease, increased intracranial pressure) may imply major potential risks. Certain anesthetic techniques may increase these risks and others may decrease them. In complicated patients, there are frequently risk tradeoffs, where a technique helpful to one problem is harmful to another, and vice-versa. ATTENDING is designed to help analyze these issues and provide feedback to help an anesthetist evaluate and optimize his management. ATTENDING is currently being used for teaching anesthesia residents.

2. The HT-ATTENDING system [5] has been developed to critique the pharmacologic management of essential hypertension. This domain is significant in that there is a varied array of drugs available, with new agents frequently appearing. The practicing physician is hard pressed to keep abreast of all these alternatives, and to know how best to use them in a particular patient. HT-ATTENDING can give a physician feedback as to how his style of practice fits in with current thinking in the field, and with the current spectrum of agents available.

3. ONCOCIN [6] has also recently been adapted experimentally to a critiquing mode of advice. ONCOCIN is designed to help a physician implement oncology protocols. Oncologic management is almost unique in medicine in that explicit protocols dictate in detail exactly how oncologic agents should be administered. As a result, ONCOCIN can critique a physician's management by indicating how the physician's plan differs...
from the protocol. This contrasts with most areas of medical management where no objective standards exist, and where a critiquing system must be more flexible, pointing out the relevant alternatives along with their risks and benefits, leaving the physician to make the final (subjective) decision.

3. Critiquing Medical Work-up

Work-up is an important area of medicine which lies between diagnosis and management. In work-up, a physician starts with a differential diagnosis, and proceeds to order tests to rule-in or rule-out a particular problem, or to assess its character and severity. Examples are 1) ordering x-ray and endoscopic procedures to evaluate GI bleeding, 2) ordering laboratory tests to rule out hyper- or hypo-thyroidism, or 3) investigating possible underlying etiologies of high blood pressure.

As in management, there may be a variety of different tests and procedures available in working up a given problem. New tests and procedures are periodically developed which may have advantages over previous tests, either overall or in certain patients. The computer could tell a physician when his planned work-up involves tests or procedures which may be unnecessary, redundant, inappropriate, or incorrectly sequenced. Here again, the system could indicate alternative approaches and discuss the relative advantages of each.

There are usually several ways to approach the work-up of a given problem. Merely listing one approach is of no major help to the physician. Also, the mere listing of a sequence of tests and procedures would be computationally trivial. This may be why work-up has not received much independent attention as an area for sophisticated computer advice. Once one takes a critiquing approach to work-up, however, the system design problems become much more interesting. Work-up may prove to be a very fruitful area for the critiquing approach.

4. Summary

The critiquing approach to medical computer advice may help to solve a number of problems which may otherwise be frustrating and prohibitive. In particular, it allows the physician to be the final decision-maker. As a result, the computer is never forced to commit itself to one approach or another. Since medical decision-making is not an objective process, but is very subjective, this protects the computer from issues which may be impossible to quantify objectively.

In the face of the tremendous variation in medical practice, it may well be that a computer advisor which does not take the critiquing approach is undertaking an extremely frustrating, and ultimately self-defeating task.

References


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