

REACT - A decision-support system for medical planning

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Abstract

Developing a care plan for a patient with a complex medical condition is a difficult task, requiring an understanding of interactions and dependencies between procedures, and of their possible outcomes for an individual patient. The REACT graphical planning system allows effective communication of this information to both clinicians and patients, with immediate feedback of constraints, interactions and dependencies on and between actions, and of the possible outcomes of proposed plans.

Background

The problem of communicating and working with risk and uncertainty is a serious one for many fields, none more so than medicine. We wish to support not only the clinician making decisions about the care of a patient, but also patients themselves, who are working at an even greater disadvantage if they wish to understand their condition and even to participate in its management.

Many decision support systems support only a single, isolated decision - for example, what drug to prescribe, or whether to refer a patient to a specialist. Most decisions, however, are made in the context of plans of action, where they may interact or conflict with other planned actions or anticipated events. For example, the planning of medical interventions over a patient's lifetime is a complex proposition with many sources of information, interactions and dependencies between interventions. We are developing a prototype system, REACT (Risk, Events, Actions and their Consequences over Time), which aims to provide effective communication of the risks and implications of planned actions in uncertain domains, to support the understanding of both clinicians and patients.

The REACT system

In effect REACT is a logical spreadsheet that allows a user to manipulate objects representing potential events and clinical interventions on a graphical timeline interface (Figure 1). It propagates their implications (both qualitative and quantitative) to displays of risk (or other parameters) and displays of logical arguments and counter-arguments for clinical options.

While the user creates a plan, a knowledge-based decision support system analyses it according to a set of definable rules and provides immediate feedback on the predicted effects of actions. Rules may specify, for example, that certain events are mutually exclusive, that certain combinations of events are impossible, or that events have different consequences depending on prior or simultaneous events). Global measures (for example the predicted degree of risk or predicted cost or benefit of combinations of events) can be displayed graphically alongside the planning timeline.

Qualitative arguments for and against each individual action proposed in the plan can be reviewed. This allows considerably more information to be taken into account in each planning decision than a simple assessment of its impact on overall risk. For example, the implications of bilateral mastectomy for carriers of a breast cancer predisposing gene range far beyond the effect of the procedure on risk of cancer. Logical arguments may also be combined to provide overall recommendations for or against specific actions when specified combinations of plan elements occur.

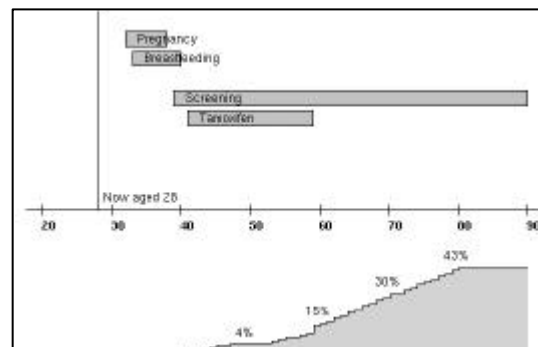


Figure 1: The REACT graphical interface being used to plan interventions to reduce risk for a carrier of a breast cancer predisposing gene. The horizontal blocks represent planned events or actions, and can be moved around by the user. Below the timeline the additional risk of death due to gene carrier status is shown, and this display reacts immediately to changes in the plan. Arguments for and against actions, and recommendations for modifying the plan, can also be displayed alongside the risk graph.