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**INM357 – Information for Decisions in Healthcare**

Critical appraisal of formal decision making methods for resolving complex decisions arising in an ever changing health care environment.

Are formal methods the key and where does our conscience comes into the process of providing care for our communities?

## **Introduction**

Every day 250,000 people in the UK will be seen by a practitioner and receive some form of treatment in the NHS according to Brennan [Brennan 2005]. 1.6 millions Prescriptions (1.5 millions from General Practitioners and 0.5 million from hospitals) are generated daily as recorded by the National Patient Safety Agency [Stephenson, 2005] and the Office of Health Informatics documented 173 deaths daily caused by some form of errors in the National Health Service [Brennan 2005]. Decision support systems and thoroughly applied decision making processes help to avoid ill-treatment and streamlining the limited resources in a modern health services like the NHS.

Nevertheless, one may argue that formal methods should not be the only approach to provide care in a social justified and appropriate manner. Medicine is a very vertisale science with a lot of influences from other disciplines such as Information Technology, Pharmacology, Biology and Social Sciences. One may say it is a form of an interlinked science forming a sort of super, hybrid machinery that ensures the well-being of our society of which we all are a part.

Decision making does not begin with making an assessment of a patient when he or she comes into Accident and Emergency department or a GP surgery. No, it starts with providing services and buildings within the community itself. A lot of decisions have to be reached, discussed and implemented before planning a new building for the local Primary Care Trust (PCT). The author's employer has recently commissioned a new care centre for the elderly in East London and a huge amount of choices had to be made before the first patients were moved over from the old hospital. All different kind of experts from different backgrounds from IT, Estates & Facilities to medical and nursing departments have been involved in setting up innovative services in a purpose built environment.

These decisions can be made with formal methods, but they also involve non-formal approaches like intuition, personal expertise and logical thinking. The author of this assignment will critically appraise formal decision making methods to maximize the best possible outcome for patients in the modern healthcare environment.

## **The formal approaches to decision making**

Several formal methods for decision making can be applied to situations in the health sector. The author of this paper would like to give a brief overview of the following three formal approaches without going into too much detail.

- Decision Trees:

Decision Trees are powerful tools to display graphically the possible outcomes of a decision with its associated utilities and probability measures. Decision trees can be used to show the different outcomes associated with a form of medical treatment (i.e. operation or chemotherapy on a cancer patient). The tree demonstrates all the decision nodes and achievable outcomes – intended and un-intended ones. The assigned probabilities and utilisation for each possible outcome allows easy calculation of the benefits of a treatment on the root decision nodes level. This method can be used to illustrate complex decision processes to a user who is not used to the environment in which the assessment has been made. It also enables unbiased judgement on which treatment or action would be more beneficial for the patient due to the structural organisation.

- Bayes Theory

The Bayes formula can be utilized to calculate the justification for tests that benefit the treatment of a patient. Not every test may be useful and of benefit for the medical assessment of an ill person in a healthcare environment (i.e. doctor surgery or Accident & Emergency department in a hospital) and therefore good reasons need to be established before a test should be requested. This becomes even more important in the situation in which the NHS operates currently where cost pressures are felt more and more. It is not possible to perform a series of tests on every patient and the Bayes formula provides us with excellent possibilities to calculate the True Positive Rate of pathological tests and their associated trustworthiness to receive reliable test results that are of use to gain recovery from an illness for the patient. The sensitivity and specificity are characteristics of reliable tests which get closer to the Gold Standard Test (the most ideal test) than less successful promising medical investigations. Bayes theory is based on the improvements that new knowledge brings into a decision. This theory requires the presence of an alternative test, which the new examination is tested against. Only if the newer examination provides significant more positive outcome then it is viable to perform the additional assessment.

- Markov Models

Markov Models represent the different stages a patient can be in during his or her life. These stages might be “well”, “ill”, “disabled” and “dead”. The patient can move from

one stage to another; forwards and backwards from certain stages. Patient A can move from “well” to “ill” and then back to be “well” again, whereas patient B can’t move from “dead” to be “disabled” or even “well”, because the stage “dead” is the final, absorbent stage from which no transition can take place. On the other hand patient C, who has broken her left leg, might be temporally disabled while her leg is in plaster cast, and therefore could move back to the stage “well” when the cast has been removed, but one might argue that patients should be only placed into situation “disabled” if they are permanently disabled and so our patient C would for that reason be placed into the “ill” stage. A clear definition of the stages needs to be specified before Markov Models are employed. The transition between the stages is specified in probabilities. The Markov Models like Monte Carlo Simulation will be applied to run simulations on the transitions between the stages until the whole Markov cohort has been absorbed by the absorbent stage. The Monte Carlo Simulation is used for longer term conditions (e.g. Alzheimer or Diabetes) that influence the life of a patient on a longer timescale and therefore it can be used to calculate the life expectancy for a person suffering from Diabetes for example.

### **Are formal decision making methods the only approach to make decisions in the healthcare sector?**

Nothing comes free of charge within the health care sector. Each assessment and treatment carries an associated cost with itself, which will need to be taken into account especially within the Public Health setting. Immunisation programs and National Service Frameworks like the ones for Cancer and Diabetes put a huge cost pressure onto local services. Public Health departments within PCTs are utilizing cost-benefit calculations before deciding to vaccinate a large group of people for example. The provision of national frameworks is also under a constant scrutiny to verify that they provide the projected benefits for the population and their cost can therefore be justified.

Healthcare analysts and accountants need to be able to justify the costs of a treatment or test put onto the trusts budget and formal decision making methods as described above provide a robust outline of the treatment’s possible outcomes and its associated charges. One could argue that these methods enable us to make unbiased decisions. On the other hand there is uncertainty about the projected outcome as not all patients react on the same way to a treatment and several other social and ethnic background information need to be taken into account. Decision Trees provide a good overview about possible outcomes of a treatment and its utilization, but it can be

difficult to assign the correct (true) utilizations and probabilities for each outcome especially for new treatments that do not relate to previous experience and where the level of uncertainty is very high.

Markov models are a great tool to model the life expectancy for a group of patients with the same condition. One could argue that it is difficult to specify the stages for complex conditions and their associated probabilities. The direction of transitions between stages needs to be clarified and one medical practitioner may not necessarily agree with his or her colleagues about the directions between stages or the order of stages. Also the source of the assigned probabilities for the transitions could be argued about. New treatments possibly have different values assigned than well established forms of illness management. Some conditions may allow the changeover forwards and backwards between stages, meaning that one patient can be healed from a condition whereas another one might not go back to the stage “well”. It has to be clarified whether a transition to the “well” stage is possible or if the transition to the “ill” stage can only be slowed down. Diabetes can lead to secondary illnesses (i.e. blindness) that have a profound influence on the quality of life and life expectancy overall.

The recommendation by NICE, the National Institute for Health and Clinical Excellence, to see the drugs “Donepezil, Galantamine and Rivastigmine” as “... not the only treatment for the Alzheimer Disease ...” in its early stages [NICE, 2006] has sparked not only a legal process to confirm whether this form of treatment should be paid for by the NHS, but also lobbying campaigns by the Alzheimer’s Society [Alzheimer’s Society, 2006] where they utilize their website and public demonstrations to put pressure on the government to overturn the decision made by NICE, have started. In an interview with the Observer newspaper the health minister Stephen Ladyman addressed the need that NICE “... needs to assess the impact its plans would have on families”, as “if you have someone in your family who has a form of dementia and you have drugs which do work, then you are going to find this decision a bit baffling” [BBC, 2005]. This case shows the social and emotional issues that formal decision making methods can not address. People with relatives or friends, who suffer from an illness, will make most likely different decisions as they are emotionally affected by the treatment options available. It shows that we are not unbiased and that our decisions are influenced by social factors. We ask the question is it recommendable to treat an illness which is incurable just to have our loved ones with us for a longer time. And we forget to easily about the consequences for the patient him/herself. His or her quality of life can so severely deteriorate that constant care is required.

Most of us have a very busy life with our family and work and we would not be able to cope with the commitment to care for a relative over a prolonged period of time.

Secondary conditions also need to be taken into account when making decisions. When deciding for the most appropriate treatment for Diabetes Mellitus, the increased cost of foot care, and the possibility of blindness needs to be taken into account. Renita screening will need to be provided to monitor the eye sight capabilities of Diabetes suffers. This requires extra resources and funding and therefore additional cost pressure on the health budget. Medication that slows down the symptoms of Diabetes or which stops the occurrence of Diabetes will be beneficial for the NHS and patient. There is always a trade-off between cost and benefit that needs to be assessed. The Markov modelling could provide a good basis for decision making in this case.

## Conclusion

The Johns Hopkins University School of Medicine in Baltimore has conducted an interesting study into the tradeoffs in clinical decisions in 2002 [Beach et al, 2003]. A survey was conducted in which physicians have to choose between different cancer screening methods on their merit of effectiveness and cost as well as frequency. It has been found that two-fifths of the participants have chosen the less effective and less expensive test which has been used more frequently to monitor patient's risks for developing cancer, as they believed "... the patients do not need the more expensive test...".

This study shows that the medical profession does not necessarily always sees the expensive decision would be the best, but that more frequent testing can have extra benefits attached to itself. This would mean that we are on a path where the frequency of tests or treatments and there associated costs have a higher influence on the decision making process.

It has to be seen whether the American approach to healthcare provision can be applied to the UK healthcare sector where the tax-based contribution has a significantly higher impact on healthcare provision. The budget is not unlimited and at some point we need to make cost-benefits tradeoffs by choosing less effective but cheaper forms of treatments. On the other hand one could argue that if you want to receive better treatment you would need to pay extra as it is common practice in other countries within the European Union. But this idea would go against the principal provision of healthcare in the UK, where the health service is free of charge at contact. The government might need to consider increasing the National Insurance contributions

if we want all the new and “fancy” treatments on the NHS. Tax increases will probably be the only way forward if we do not apply healthcare rationing through formal decision making methods.

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