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**Decision Making and Judgement in
Radiographic and Sonographic
Practice. An investigation using
Decision Analysis**

This thesis is submitted for the award of PhD

**Applied Social Sciences
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Abstract

This is a study into decision making and judgement in the context of radiography. The early part of the study investigated the nature and scope of decisions and judgements made in general radiography and sonography, while the later part focused on the decisions and judgements made by sonographers when breaking bad news to patients. The study is located in a broad interpretative framework, it used an adapted form of phenomenological methodology. A survey and an observational study were used to collect data. In-depth interviews were conducted which used decision analysis (a tool normally used as a decision aid) to elicit participants perceptions and experiences of decision making and judgement.

Decision analysis was used in three different ways to collect data. The technique was found to be particularly useful in enabling participants to reflect on their intuitive processes and hence make them overt.

The data collected during the observational phase of the study was used to formulate a classification of radiographic decision making and judgement. The study found that the predominant style of decision making and judgement in radiography is intuitive with some evidence of peer-aided decision making and judgement. There is little evidence that the participants use systems aided approaches. Participants found the process of decision analysis interesting but could not relate its use to their own professional practice other than as an educational or de-briefing tool.

In sonography it was found that participants had an over-confidence in their diagnostic abilities which influenced their decision making. Sonographers were also found to produce information based on experience, when this information was absent from the decision making scenario provided. On the whole the participants in this study had given little thought to the process of decision making and judgement and the impact of factors such as base rates.

This work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution. To the best of my knowledge and belief, this work contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Scott Bowman

Date

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Chapter 1

Judgement, decision making and radiography

1.0 Introduction

Medical imaging is an exciting, fast moving field within health care. The roles and duties of the professionals working in this field (radiographers) are evolving almost as quickly as the technology they use. In this chapter a history of radiography is presented, in which it will be shown that the radiography profession has come virtually full circle in terms of the role of the radiographer. Soon after x-rays were discovered, non-medically qualified radiographers undertook x-ray examinations and produced diagnostic reports on them (Price & Patterson 1995). Later this role was reduced to the production of the radiographic image with the diagnostic reporting on the images being undertaken by the medical profession. Now, at the turn of the following century radiographers are once again reporting on the images that they produce using both x-radiation and ultrasound. Radiographers working in ultrasound practice (sonographers) are also charged with discussing their findings with patients (Price & Patterson 1995). This sometimes involves conveying bad news, such as death of the foetus (Moulder 1998). The role of the radiographer is now far removed from simply producing diagnostic images (Robertson 1998).

Paralleling the changing role of the radiographer has been the changing scope and nature of the judgements and decisions being made. The judgements and decisions made by radiographers, in particular those working in ultrasound, lie at the heart of this study. The current state of professional judgement and decision making in radiography and its history will be considered in this chapter.

1.1 Rationale for the present study

In the course of working as a radiography and sonography educator the author of this study became interested in clinical judgement and decision making. Through working as a tutor for Open University's "D300 Professional Judgement and Decision Making" course he became aware of the many different approaches to judgement and decision making and how different healthcare professionals address judgement and decision making in their own professional contexts. During his time as a tutor for the Open University the process of decision analysis particularly impressed the author. This is a technique that is primarily used as a decision aid (Dowie 1993), but the author was also impressed at the ability of decision analysis to make decision making and judgement processes and issues overt. Accordingly, for this study the author chose to use decision analysis to investigate decision making and judgement in sonography.

Another reason for undertaking this study is that the author saw in clinical practice the impact on patients when health care professionals get decisions and judgements wrong. From personal experience the author could not agree with Hamm and Zubialde (1995) who state that errors are abundant, but usually they are small and

innocuous. The effects are often wide-ranging and far from innocuous and the author would agree with Schultz (1996) who states that mistakes occur and they are not rare. If this study can in any small way help to reduce the mistakes made in medical professional decision making and judgement then it will have been worth doing.

Given the growing importance of radiographic judgement and decision making this study is timely. It is important that the radiography profession begins to consider its new roles from a judgement and decision making perspective. By doing this, a greater understanding of radiographic professional practice can be gained and hopefully improved. Dowie (1993) provides a lead here by listing five questions that can be asked regarding clinical judgement and decision making, they are:

- 1) *How are clinical decisions made?*
- 2) *How well are clinical decisions made*
- 3) *How could they be made*
- 4) *How well could they be made*
- 5) *How should they be made*

(pp 12-13)

At present there is little in the literature to suggest that research has been undertaken to address these important issues within radiography. This study will investigate decision making and judgement within radiography and sonography. This study will focus on Dowie's first question – "how are clinical decisions made?" Before doing this, the scope and nature of decisions made by radiographers will be established. This is important because within radiography the nature of radiographic decision making has not been established. If answers to Dowie's first question can be provided it is hoped that this study will contribute to the answering of the other four questions within the context of radiography. It is hoped that this study will motivate

others to undertake work in this field, and for the issues raised to gain greater prominence within and even beyond the radiographic profession.

While working for the Open University as a tutor of the “D300 Professional Judgement and Decision Making” the author became interested in the relationship between judgements and decisions in his own field of professional study. After some reflection it was concluded that little was known about how radiographic judgements and decisions are related in radiography. For this reason it was decided to include a research question addressing this issue in this study.

Decision analysis and its application is discussed in chapter 2. By using decision analysis as the primary research tool, the study also sets the research question “Can decision analysis be used to investigate decision making and judgement in a professional context?”

In summary the research questions being set for this study are:

- 1) What is the scope and nature of clinical judgements and decisions in radiography?
- 2) How are these judgements and decisions made in radiography?
- 3) What is the relationship between judgements and decisions made in radiography
- 4) Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?

From these research questions it can be seen that this study has two broad aims, **firstly** to investigate decision making and judgement within radiography and **secondly** to establish if decision analysis can be used as a research tool.

Radiography is a professional discipline, which covers many different medical imaging applications including x-ray examination, Computerised Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine and Ultrasound. This study investigates two areas of radiographic practice: firstly general radiography using x-rays (referred to in the study simply as “radiography”); and secondly sonography which uses ultrasound to produce diagnostic images. As the study progressed a decision was made to focus the study within one discrete field of radiography and a particular area of decision making and judgement within that field: ultrasound practice and the “breaking of bad news”. This decision was made after an observational study of radiographers and sonographers was conducted by the researcher. The research questions are hence addressed in relation to the breaking of bad news within ultrasound practice. The reasons for this decision are discussed in chapter 4.

The remainder of this chapter reviews the literature that is of relevance to these research questions. This review begins by considering the topic of decision making and judgement before concentrating on the development of radiography. This process was used to contextualise the research and to establish the work already carried out in this area. A review of decision analysis and the relevant literature is covered in Chapter 2.

1.2 Decision making and judgement

The prime focus of this study is decision making and judgement within radiographic practice and the application of decision analysis as a research tool. To be able to address the research questions “how are decisions and judgments made?” and “how are they related?” the nature and scope of decision making and judgement within radiography must be considered. The distinction between the process of making decisions and the process of making judgments is not always clear. Judgments are made when a person values an object, action or attribute. It is a process of normalisation; in other words, people use their experience to estimate a value against a normative scale. In most cases this normative scale is a personal scale. For example, a radiographer could judge how much pain a patient is experiencing based on the cues given by the patient.

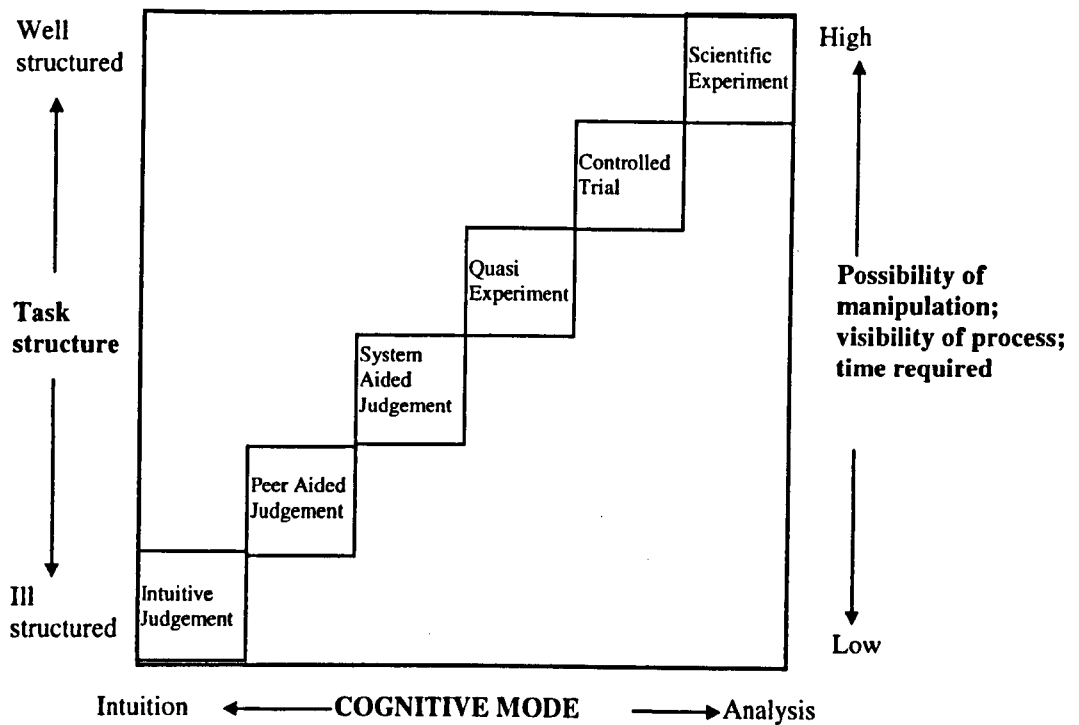
For the purposes of this study decision making is defined as the action of choosing between alternative courses of action. In the example of patient pain determination the decision that the radiographer makes is the action to take having judged the patient’s state of pain. It could be argued that this is only one aspect of the whole decision making process. There are many examples of decision making models or processes. One of the first was proposed by Dewy (1910) in his book "How we think." This model put the decision making process into a problem-solving context in which the stages were identified; defining, identifying alternatives and choosing the best one. Simon (1960) also advocated three-stage process: intelligence, design and choice. Russo and Schoemaker (1992) put forward a four-stage model that involves framing, gathering intelligence, coming to conclusions and learning. Some authors

(Russo and Schoemaker's 1992, Bandman & Bandman 1988) have presented such models of the decision making process as decision aids. They may be aids in that they make the decision making process more transparent and give decision makers a framework for reflection, however, there are fundamental differences between these models and decision making aids such as decision analysis, which is described in chapter 2. The major difference is that decision making aids do not give the user overt guidance on which course of action to take. To address the research questions set in this study decision making will be regarded as the choosing between possible courses of action.

1.2.1 Approaches to decision making and judgement

Debate rages within medicine, nursing and the allied health professions regarding the best approach to decision making in professional practice. As far back as 1954 Meehl summarized the conflict between those advocating the use of quantitative analytical approaches and those who saw medicine more as an "art" and who defended and extolled the virtues of more intuitive methods.

Hammond (1980) in his cognitive continuum provides a framework with which to conceptualise different decision making modes ranging from intuition to scientific method. This is shown in Fig 1:



The six modes of enquiry from Hammond

Fig 1 The cognitive continuum.

Source Hamm (1984) cited in Dowie and Elstein (1988).

On the basis of this diagrammatic representation, Hammond argues that there are six broad modes of practice and enquiry on the continuum ranging from intuitive to scientific experiment. The diagram also demonstrates that the mode of practice to be used in decision making is determined by:

- a) the structure of the task;
- b) the possibility of manipulation of data;
- c) the required or expected visibility of the process;
- d) the time available.

When considering the cognitive continuum it is important to distinguish between the mode of cognition and the mode of practice. The mode of cognition is the type of thinking that is taking place in the practitioner's brain mind. The mode of practice is

the method that is being used by the practitioner to make decisions and judgements. Different modes of practice have varying ratios of analytical and intuitive cognition.

1.2.2 Intuition and analysis

Hammond's model shows us that professionals practice on a continuum that ranges from predominately intuitive to moderately analytical (i.e. the three lower boxes in Hammond's diagram). One of the key research questions within this study is to establish how sonographers make decisions and judgements. If Hammond's model is accepted then the answer to this research question will involve consideration as to where on Hammond's continuum sonographers are practising. The meaning of the terms analytical and intuitive practice must be clarified if this question is to be addressed.

The intuitive approach to decision making has been described as "understanding without rationale" (Benner & Tanner 1987). The subtitle of Benner and Tanner's paper gives some indication of what they mean by intuition "*The seasoned nurse's well-honed sixth sense enables her to make lifesaving decisions*". Intuition tends to be subjective and based on experience (Benner 1984). Benner (1984) also defines intuitive grasp as:

"Direct apprehension of a situation based upon a background of similar and dissimilar situations and embodied intelligence or skill. Intuitive grasp is never "blind" as in a wild guess, but relies on perceptual capacity based upon prior experience. Intuitive grasp should not be confused with mysticism, since it is available only in situations where deep background understanding of the situation exists, based upon a broad base of

knowledge and experience. Intuitive grasp makes expert human decision making possible. It allows a gestalt or holistic understanding that bypasses building the situation up element by element and then grouping or synthesizing the elements into a conclusion or whole picture. Intuitive grasp is not possible without sufficient background and experience with many similar and dissimilar situations.”

(pp295)

Benner, Hooper-Kyriakidis and Stannard (1999) give a more concise definition of intuition:

“the direct understanding of particulars in a situation without conscious deliberation, awareness, or articulation. Intuitive grasp is based on experiential background of similar and dissimilar situations”

(pp568)

These definitions of intuition come from its strongest advocates. Hamm (1988) on the other hand gives a less sympathetic definition:

“intuitive thought involves rapid, unconscious data processing that combines the available information by “averaging” it, has low consistency, and is moderately accurate”

(pp82)

Intuitive decision making can take a number of forms but the dominant one is pattern recognition. Dreyfus and Dreyfus (1985) identify what they call the six key aspects of intuitive judgement. These are: pattern recognition; similarity recognition; commonsense understanding; skilled know how; sense of salience and deliberative

rationality. Benner and Tanner (1987) have shown how these key aspects are used by expert nurses in their professional practice.

There are a number of advocates for the use of intuitive judgement (Benner 1984, Benner, Hooper-Kyriakidis, Stannard 1999, Dreyfus 1980, Cioffi 1997). One of the strongest cases is put forward by Dreyfus (1980) and developed by Benner (1984). It is argued that experts make the best decisions when they take an intuitive approach. Dreyfus (1985) states that people progressively develop their decision making abilities from novice to expert, passing through stages of advanced beginner, competent and proficient. He goes on to state that at the novice end of the spectrum decisions are made analytically and at the expert end they are made intuitively. Rolfe (1997) has argued that Dreyfus developed his theory by drawing heavily from the field of computing, and because computer programmers could not develop an expert system which replicated the way human experts think. He concluded that experts do not follow logical rules and hence behave intuitively. Rolfe argues that this is a weakness in Dreyfus's model.

Well before Dreyfus (1980) and Benner (1984 and 1999) had advocated intuition, Kaufman (1968) argued that decision making should move away from intuition because of the growing complexity of the world. The main reason given for this growth in complexity is the "constriction of time" or as Kaufman explains the acceleration of history. This phenomenon seems to have come about because of a) the widening of structures, b) the increase in the speed of communication and c) transmission of information. With the development of technology, data is processed

and communicated much more effectively and faster, and there is a need for more productive ways of making decisions regarding this data. Kaufman argued that with this increase in data processing there is no time to study all facts in preparation to make a decision. This was an argument put forward in 1968 before the massive expansion in the use of computers and electronic data transmission. Kaufman's "constriction of time" and growing complexity of the world is certainly to be found in medical imaging departments. If Kaufman's argument is to be accepted there should be a move to more analytical decision making in medical imaging practice.

Friedman *et al* (1980) has produced powerful evidence to show that intuitive models of decision making are too simplistic. In their study they demonstrated that the well-known differences between male and female blood data were not used when surgeons are considering blood transfusion intuitively. Dawes (1976) has gone as far as to say that those who advocate intuitive methods suffer from "cognitive conceit" and that they are prevented from recognising this because of their limited cognitive capacity. There is strong evidence to show that people cannot process information without "distorting it or leaving out important parts" (Slovic and Lichtenstein 1971, Simon: 1979). Eddy (1980) indicates another problem with cognition in a study concerned with cancer screening in which he cited a case where doctors equated the chances of a woman who has cancer having a negative test with the chances of a woman with a negative test having cancer. They argue that those thinking more analytically would have seen the flaw in the argument. Another attack on cognition in the form of limited memory comes from Gill *et al* (1975) who demonstrates that even when doctors are asked simple questions concerning history taking they make mistakes. Craven *et al* (1975) highlighted cases where doctors have overlooked important

clinical information indicating TB because they were more concerned about looking for acute causes of illness.

Health care professionals also undertake their decision making in complex social relationships. Both of these aspects influence the decision making process and Robinson (1978) and Friedson (1975) have indicated that in most cases these motivate the professional to be active rather than passive. This is illustrated by a classic study undertaken in 1934 by the American Child Health Society that is used as evidence of the unscientific basis for much medical decision making (Eddy 1984). In this experiment two doctors examined 389 eleven-year-old children: 174 (45%) were recommended for tonsillectomy and the remaining 215 were re-examined and of these 99 (46%) were recommended for tonsillectomy. The remaining 116 were yet again re-examined and of these 51 (44%) were recommended for tonsillectomy. This study has been used to demonstrate the bias towards action of medical practitioners. Ayanian and Berwick undertook similar research in 1991. This research used “paper patients” and it was found that the doctors in the sample group were biased towards action in relation to tympanostomy tube placement and radiography. It was however found that the same bias towards activity was not present for the referral of patients to emergency room evaluation. The paper proposed four explanations for the research findings; 1) that doctors did have an inherent bias towards treatment (particularly low risk ones) 2) that decisions made may have reflected initial views of prior probability of disease, 3) that the decisions reflected the doctors levels of expertise and 4) that the results are due to the statistical phenomenon of regression to the mean. These studies which considered intuitive medical decision making do seem to cast doubt on the reliability of such decision making.

Price and Price (1997) put forward a powerful argument against intuitive decision making in midwifery practice. They state that it is an insufficient defence to argue that midwifery decision making is intuitive and artful when accounting for professional practice. They go further in arguing that expert decision makers can share their wisdom with less experienced practitioners. This is opposed to the Benner approach that asserts that expert decision making can be achieved only by intuition that is gained through experience.

If some such as Price and Price (1997) argue so strongly against intuitive thought it is worth considering the alternative – analytic thought. Hamm (1988) has defined analytic thought as:

“Slow, conscious, and consistent; it is usually quite accurate (though it occasionally produces large errors); and is quite likely to combine information using organising principles that are more complicated than simple averaging.”

(pp82)

Analytic approaches to decision making and judgement can be defined as those where logical processes of induction and deduction predominate (Radwin 1995). They are also approaches where factors such as emotions, affect, context or intuition are considered irrelevant or sources of interference with prescriptive approaches (Gardener 1985).

As with intuitive practice there are those that advocate such an approach (Dowie 1988, Janis and Mann 1977, Elstein *et al* 1978). Moore and Thomas (1988) have

stated that uncertainty is present in almost all problem situations and that it must be coped with. Where uncertainty can not be eliminated they advocate the use of "hard thought" in the form of decision analysis.

Dowie (1992) argues that there are some very useful reasons for using decision analysis. He states:

"...the key difference between intuition and analysis is that analysis, by definition, breaks things down in order to seek greater understanding, whereas intuition retains the wholeness. As a result analysis spells things out and facilitates discussion. The case for analysis is that our progress towards better understanding or decision making will be greater if we break the problem down - "decompose" it in my jargon - into more manageable sub problems, solve them and then bring the sub answers together to get an answer to the original problem. And each element or step in the process followed can be opened to peer and public debate - even allowing attempts at replication by complete strangers on the other side of the world".

(pp25)

If this argument is correct then the process of analysis would seem to be a very useful research process and it could be argued the process that the positivist tradition of research is based on. This statement also indicates that levels of practice well below scientific experiment on Hammond's continuum could also be used for research purposes.

There are those who do not advocate the use of analytical practice. Others do not believe that there is a need to be analytical in evaluating clinical decision making (Schon, 1983). Schon is concerned about the dangers of analyzing clinical judgment in the scientific manner.

There is some limited evidence to support the view that some analytical approaches can be out performed by humans intuitively, and that this approach can be detrimental to the decision making process. Dannenberg *et al* (1979) showed that humans (doctors) out performed a computer model in predicting the chances of events concerning lupus erthematosis. This researcher also demonstrated that the use of analytical methods, in this case a computer program, could be detrimental. When doctors were given feedback from the computer their prediction accuracy was reduced. But the bulk of the evidence is in favor of analytical approaches.

Dreyfus & Dreyfus (1985) and Schon (1983) argue for a more intuitive approach to decision making. Hammond's continuum was considered by Hamm (1988) in relation to work carried out by Dreyfus and Dreyfus. He came to the conclusion that there are contradictions between the two theories but that the two approaches are complementary because Hammond's methods map onto the Dreyfus' process. Leaper (1972) states that there is no one way in which doctors make decisions - they change their strategies with the difficulty and urgency of the case. In clinical practice the task is often ill structured and time is limited which limits the modes available to the practitioner. Often the only modes available to the practitioner are intuitive judgment,

peer aided judgement and systems aided judgment. The other modes on the continuum are more appropriate to research practice and inquiry.

Even Benner (Benner and Tanner 1987) concludes that

“intuitive knowledge and analytic reasoning are not in an either/or opposition; they can - and often do - work together”

(pp31)

Further, Hamm (1988) states that:

“Most thought is neither purely intuitive nor purely analytical, but rather lies somewhere in between. This “in-between” or “quasirational” cognition can have intermediate values on the features (eg it could take moderate amount of time), or it can have a mixture of features (some features which are characteristic of analysis and others that are characteristic of intuition), or finally, it can involve alternation back and forth between analysis and intuition.”

(pp82)

It can be seen from these two statements that even the strongest advocates of intuition or analysis recognise the role of other modes of thinking and practice. This supports the work of Hammond and his cognitive continuum in that Dowie (1992a) advocates the mode of thinking and practice (and hence decision making) which best fits the structure of the task, time limitations and, most importantly, which gives the best outcome. Mary and Nettleman (1989) argue that doctors rely on clinical trials for information regarding new products. These are rarely undertaken in the patient

population that they work with. They also argue that decision analysis is a method for integrating the results of clinical trials with data regarding their own patient populations. Sackett *et al* (1991) notes, in this context that the results of clinical trials and research do not always match the population that the clinician is working with.

As well as analytical and intuitive approaches to decision making there is also some evidence to suggest that people do not take any particular approach but instead try to avoid decisions. Dowie and Elstein (1988) state that denial and avoidance are characteristics often found.

1.3 Radiography

This study takes place within the field of medical imaging within the United Kingdom and focuses on the practice of radiography and ultrasound. To understand fully the research presented, histories and backgrounds of these professions must be considered.

X-rays were discovered in 1895 and within the year were being used by the medical profession. Some doctors purchased their own apparatus and performed their own examinations, diagnosing from the images that they themselves produced. These doctors were appointed “hospital electricians” (Goodman 1993), however, non-medically qualified personnel, the early radiographers, performed most of the x-ray examinations. They produced and interpreted the radiographic image and by the 1920s, a new speciality had been born – radiography. Those who practised it being

called radiographers. Radiographers made diagnostic as well as technical decisions and judgements in the early days of the profession.

In 1921, the Society of Radiographers (SOR) was established. The Society acted as the professional body for radiography and established professional standards and training courses for radiographers. The SOR also developed a code of practice for radiographers, which defined the role of the radiographer.

In the 1930s, the Board of Registration of Medical Auxiliaries (BRMA), the precursor of the Council for Professions Supplementary to Medicine (CPSM), was established. This body was an arm of the Privy Council. It was established to safeguard the general public against unqualified practitioners in a number of the professions allied to medicine, including radiography. Larkin (1978) has argued that the BRMA was established to control the radiographic profession and to safeguard the status of the medical practitioners who were involved in the field of diagnostic imaging.

In 1960 the BRMA became the CPSM. This body accredited training courses and established a register of qualified practitioners. Only people who had followed an accredited training course were allowed on to the register and practitioners had to be on the professional register to practice in the National Health Service (NHS). The CPSM also developed a professional code of practice that further contributed to defining the role of the radiographer. Moodie (1970) saw the CPSM as a great step forward for the professional standing of radiographers stating that it “was a remarkable achievement and on paper at least it put an end to the master servant

relationship with the doctor". Price and Patterson (1995) argued that little changed with the introduction of the CPSM.

This Society established a membership qualification in radiography (Member of the Society of Radiographers MSR) that became the Diploma of the College of Radiographers (DCR) in 1977 after the Society of Radiographers established a sister organisation, the College of Radiographers (COR). Students initially studied for two years to gain these qualifications, but the length of training was changed to three years in the early 1980s (Edwards *et al* 1995). In the late 1980s, the profession began to move towards graduate status and by 1994 all students embarking on radiography courses in the United Kingdom were undertaking degrees.

Prior to 1980 radiography education in the United Kingdom took place in hospital-based schools of radiography. These were widespread, small and provided for the needs of the hospital in which they were sited. From the 1970s, there was a gradual reorganisation of schools with many mergers and closures. When the profession achieved graduate status, radiography education moved into higher education, and all are now departments within universities or colleges of higher education in the United Kingdom (Jordan 1995).

1.3.1 Radiology and radiography

There is a division of labour within medical imaging between radiographers and radiologists. Radiologists are medical doctors who have specialised in radiology. Radiology is a branch of medicine which uses a range of ionising and non-ionising radiation (x-rays, ultrasound, radioactive isotopes, and magnetic resonance) to

undertake diagnostic procedures and to a lesser extent, therapeutic interactions. In the more invasive procedures, which involve minor surgery radiologists carry out the procedure, produce diagnostic images and give an opinion on these images to other doctors. Indirect radiology involves the radiologist giving an opinion on diagnostic images that have been produced by radiographers. Radiologists carry the rank of consultant in the NHS.

One year after the discovery of x-rays in 1895, the Roentgen Society was established in London. The membership of the Roentgen Society comprised medical practitioners and physicists. Soon after the Roentgen Society was formed a purely medical organisation was established which later became the Royal College of Radiologists. It is also important to note that when the Society of Radiographers was founded in 1921 the president and six of the 18 original council members were medical doctors. Larkin (1978) puts forward a very strong argument that the early organisation of the medical imaging societies ensured that the medical profession maintained control of this important, emerging technical field. Larkin cites article 23 of articles of association as evidence for this argument. This article was included in the articles of association at the insistence of the General Medical Council. These articles were produced when the Society of Radiographers sought incorporation to become a corporate body. Article 23 reads as follows:

“No non-medical member ... shall accept patients for radiographic, radiosopic or therapeutic work except under the direction and supervision of a qualified medical practitioner, and any breach of this regulation shall be deemed conduct unfitting the member guilty thereof to remain a member of the society.”

Following the promulgation of this article, those who were medically qualified had almost complete control over radiographers reducing their right to make clinical decisions and judgements. From 1924 until the 1990s the radiographic role was confined to producing diagnostic images and taking care of the patient during the examination. The radiographer also assists the radiologist in the more complex radiological procedures, such as invasive procedures that involved some degree of minor surgery.

The role of the radiographer has always involved the production of medical images that can be used by medical practitioners to make a diagnosis of illness or disability. Until the early 1970s, radiography involved predominantly the use of x-radiation and photographic film, although the use of radioactive isotopes had developed in a parallel fashion as a separate modality. In the United Kingdom nuclear medicine practice was undertaken by radiographers who had completed specialist post basic education (Diploma of Medical Ultrasound and Diploma of Radio Nuclide Imaging (DRI). In the 1970s new modalities started to gain popularity and these included Computerised Tomography (CT), Ultrasound, Magnetic Resonance Imaging (MRI) and Thermography. The radiographic profession rapidly adopted these new modalities as they became available and new qualifications emerged. For instance, the College of Radiographers established a Diploma in Medical Ultrasound. With the movement to graduate education these qualifications became post-graduate awards and now qualified radiographers can undertake masters degrees in Medical

Ultrasound, Magnetic Resonance Imaging, Nuclear Medicine and Computerised Tomography.

In recent times, the boundaries between the radiographic and radiological roles have become blurred. For example, radiographers now routinely perform the barium enema examination that was traditionally performed by the radiologist. Most of the radiographers undertaking this role have post qualification training in this field. Radiographers are also becoming involved in the field of image interpretation (Bowman 1991, McKay 1995, Nuttall 1995, Divers 1995, Robinson 1996). This trend began with the introduction of radiography abnormality detection schemes (Cheyne *et al* 1987). There are now courses available to radiographers who wish to extend their role into this area.

There is, however, controversy over the extended role of the radiographer particularly in image reporting (Robinson 1996, Price 1996). This has led to some animosity between radiographers and radiologists (Price 1996). Even with the move to an extended role, reports produced by radiographers are often countersigned by the radiologist. The radiologist's professional body, the Royal College of Radiologists, has a policy of allowing some delegation of the radiological role to the radiographer. In its Statement on Reporting in Departments of Clinical Radiology (1995) it states:

"After suitable training there may be no statutory impediment to a non-medically qualified person reporting a radiological examination and making clinical observations, but a person without medical training cannot reasonably be expected to provide a medical interpretation".

Although this statement does lead to some confusion over the difference between a report and a medical interpretation, it does clearly demonstrate that the radiological professional body conceded that radiographers could comment on medical images. Although it should be noted that the Royal College of Radiologists (1994) have stated that it does not support independent interpretation and reporting by non-medically qualified staff and in 1996 that radiologists are responsible for the final clinical interpretation of examinations.

In 1994, the CPSM changed its statement on Infamous Conduct to allow radiographers with appropriate training to make written comments on radiographs. Bates *et al* (1994) notes that in ultrasound this had been happening in both obstetric and abdominal ultrasound. These advances clearly demonstrate that the radiographic profession has made up considerable ground that was lost in the 1920s. The scope and nature of decision making and judgement in radiography has also changed. From the mid 1990s radiographers in the United Kingdom began to make high level decisions and judgements that directly impacted on the care and treatment of their patients.

1.3.2 Medical ultrasound.

In the 1970s, a new imaging technique known as ultrasound was developed. This uses sound waves to produce diagnostic images of the body. Medical Ultrasound had many advantages, the main one being that it is safe and does not have any of the known dangerous side effects of x-rays. Ultrasound is now used to image most parts

of the body, but has been particularly successful in imaging the abdomen and the foetus in pregnancy.

The person undertaking the ultrasound examination is termed a sonographer. When the modality was first developed most sonographers were medically trained. As the use of the ultrasound grew, other professional groups became sonographers. By far the largest groups using sonography are radiographers, but midwives and nurses also have become sonographers. A sonographer can be defined as a health care professional educated in medical ultrasound and uses it to undertake diagnostic procedures.

Medical ultrasound has presented the radiography profession many new and interesting challenges. The modality is operator dependent with the sonographer performing the scan being the person who is best placed to interpret from the image. This has created a problem in that the code of practice from both the COR and the CPSM state that radiographers must not diagnose. In recognition of the problems faced by the sonographer the CPSM changed its code of practice so that radiographers could describe images they produced.

There is considerable scope for sonographers to make judgements and decisions. They must interpret the images that they are producing often in real time (dynamic images that are being viewed on a monitor). They also make reports on these images and in many departments communicate their findings to the patient.

1.3.3 Decision making and medical imaging

Although the term radiographer is used throughout the world the meaning of the term is different from country to country. Finch (1997) points out that there are vast differences between what radiographers do in different countries. The extended roles that are reviewed in this chapter are to be found in the UK, in many other parts of the world radiographers have not extended their roles to such an extent. From the preceding review of the history of radiography in the United Kingdom it has been established that radiography is a relatively new profession which is developing not only in terms of the techniques, but also in the professional role. Radiographers are now performing some tasks traditionally performed by medical doctors, this is a trend which is being seen across medicine. Richardson (1995) estimates that other professions could undertake 70% of medical tasks. When radiographic role changes are considered it is found that one of the greatest is the move towards radiographers making more judgements which in turn can have greater importance to the patient in terms of treatment.

In the past, the primary judgement that radiographers made related to the technical quality of the radiograph they produced and their primary decision was to repeat or not repeat the examination. Radiographers are now beginning to make judgements that are diagnostic. In relation to ultrasound, Nuttall (1995) points out that, in her hospital, sonographers report on all scans undertaken and also refer patients on to genetic studies. Nuttall states that sonographers discuss their findings with the patient. Particularly in the field of ultrasound, the role of the radiographer has developed considerably. To undertake the role that Nuttall outlines high level judgements and decisions are often required.

The ability to make decisions in a rapid and accurate manner is one of the most underestimated of radiographic skills (Bowman 1997). Radiographic decisions are frequently made in a stressful environment and the outcome often has important consequences for both the radiographer and the patient. It is therefore interesting to note that there is very little literature on this subject and even fewer relevant studies.

1.4 Breaking bad news

The research questions within this study are answered in the context of sonography, in particular with regard to the breaking of bad news to patients by sonographers. This can be regarded as an extended role, one which in the past sonographers have not undertaken. The type of interaction between sonographers and patients is regulated by the College of Radiographers COR and the Council for the Professions Supplementary to Medicine CPSM. This includes regulations governing what information sonographers are permitted to give to patients.

Sonographers work under two codes of professional conduct, one from the College of Radiographers (1994) and the other from the CPSM. These codes have a number of clauses that are relevant to sonographers who break bad news to patients as part of their professional practice. Under the Section 1 attaining to “Relationships with, and responsibilities to, patients” the COR code has a Statement of Principle 1.1 regarding confidentiality. It states:

“Radiographers must hold in confidence any information obtained through professional attendance on a patient.”

The note that follows this statement reads as follows:

“Radiographers may discuss, with the patient, information obtained as a result of a diagnostic or therapeutic procedure. Normally this will be in accordance with an agreed scheme of work developed within the employing authority.”

(pp3)

Under the Statement of Principle 1.3 attaining to “Respecting Patients’ Rights” the code states:

“Radiographers should ensure that patients are provided with information about their examination or treatment prior to, during and after the examination or treatment. They should ensure that patients leave the department understanding the appropriate follow-up procedure.”

(pp4)

In section 4 “Professional Standards” Statement of Principle 4.5 attaining to “Role Development” is relevant to the sonographer. The state Statement is as follows:

“Radiographers should develop their professional role. This may be done provided that: they have been properly trained for the role development; there is an agreed written scheme of work; and the employing authority has been informed in writing and assured of the radiographers competence.”

(pp10)

Two of the notes that follow this statement are also noteworthy:

“Radiographers may provide a verbal comment on image appearance to the patient and should provide a written report to the referring clinician”.

“The notes above provide examples of professional role development activities. Radiographers are encouraged to initiate and participate in other professional role development activities.”

(pp10-11)

In 1998 the COR developed and published a set of occupational standards for ultrasound practice. The COR stated that these standards defined good practice and demonstrated what “needs to be achieved in the delivery of high quality services”. The occupational standards do make reference to communication with the patient under the Unit titled “Acquire, interpret and report diagnostic ultrasound information”. Within this Unit there are a number of elements of competence. Element of competence 1.3.4 is “Support patients and their companions following diagnostic ultrasound examinations. The performance criteria stated that are relevant to the breaking of bad news for this role include:

- 1) giving accurate information about outcomes of the examination to patients consistent with the practitioners role in the setting*
- 2) offering appropriate support to patients and their companions*
- 3) confirming patients understanding of the information with them*

(pp18)

The radiographer’s professional body has produced the codes and standards considered so far in this section. If a radiographer or sonographer broke these codes then the maximum penalty would be their removal from the professional body. Breaking the codes set by the CPSM could have a much more serious consequence

for the radiographer. In this case the radiographer could be removed from the professional register and barred from practising in the NHS. It is therefore important to review relevant documentation from the CPSM. The CPSM issues a statement “Infamous Conduct” (1993). This states that:

“No registered radiographer should:- hold himself/herself out as a person who by training and experience is professionally qualified to diagnose or treat injury or disease...”

(pp2)

This statement would seem to inhibit much of the diagnostic role of the sonographer and the developing diagnostic role of the radiographer. This is not the case and the statement goes on to assert that the Committee would not find it a breach of this requirement if a radiographer:

“Provides a verbal comment on image appearances to the patient and written comment to the medical practitioner enlarging on those made verbally, provided such comments form part of a scheme of work agreed by medical staff, radiographers, and the employing authority.”

(pp2)

The statement therefore allows radiographers to give information to the patient and the referring clinician so long as there is a scheme of work in place. There may be some tension between the statement issued by the CPSM and the code published the COR. The COR code states that radiographers “should” give information, whereas the CPSM statement says that this can only be done when there is a scheme of work in place.

The Stillbirth and Neonatal Death Society (SANDS) have produced “Pregnancy loss and the death of a baby Guidelines for Professionals” (1995). These also advocate that sonographers should give results to patients at the time of the scan. The guidelines state:

“When a scan is needed because of a problem is suspected, it should ideally be managed by a professional specially trained in obstetric ultrasound and able to interpret and impart scan information straight away...”

“If problems are discovered unexpectedly during a routine scan, parents should be told immediately by the scan operator...”

(pp12)

From this review of the codes of conduct, occupational standards and guidelines that sonographers conform to, it would seem that radiographers not only have the authority to communicate ultrasound findings to the patient they also have a responsibility to do so. But communication with patients is not so easy as Moulder (1990) points out. She suggests radiographers have a tradition of “not telling” (1990, pp19). Further she asserts that in their radiographic training sonographers have little or no training in how to break bad news.

Moulder (1998) in a study of pregnancy and loss found that sonographers explain the need for referral to a doctor in general terms but when asked direct questions answer honestly. One of the problems associated with the breaking of bad news by sonographers is that they work under pressure and often only have between 5 and 10

minutes to undertake the scan (Moulder 1998). Moulder also refers to the importance of the scan in the process of breaking the bad news about a pregnancy:

“However much the women had been prepared for bad news by the GP or SHO, or because of the symptoms they experienced, it was the scan that when they fully realised that their pregnancy had failed.”

(pp38)

Moulder (1998) also found that women who had had problems with pregnancies felt that sonographers had handled the scans well. This is reassuring considering the scan is regarded as being so important and the sonographers being under such stress.

The policy document produced by SANDS (1995) also acknowledges that communicating bad news is difficult and that there can be a conflict between the needs of the patient and the feelings of the operator:

“The most problematic part of the scanning procedure is the communication of the information which is obtained. Parents usually realise when something on the scan is causing concern, and since the results of the scan are of such immense importance to them, they need and deserve to know what has been found out as soon as possible. Professionals on the other hand, knowing parents anxiety, are themselves extremely anxious not to make a mistake and need time to read the scan and to make certain the diagnosis. They may need time to find the right words in which to explain what they have just see.

These problems do not, however justify scanning in silence, or unexplained delays in sharing information with parents. It is important that

strategies are found to overcome the problems experienced both by professionals and parents.”
(pp12)

This account demonstrates that the breaking of bad news in ultrasound practice can be an important aspect of sonographers professional practice. It is concluded from this that this area of professional practice would be an excellent area on which to focus this study, because it is a controversial area in which sonographers have to make many important judgements and decisions. These judgements and decisions are different to those traditionally made within radiographic practice due to the extended role of the sonographer.

1.5 Conclusion

The rationale for undertaking this study has been examined. The prime motivation for undertaking this study was the author's joint interest in judgement and decision making and radiography. The broad aims of the study address both of these interests. This chapter has also introduced the reader to the field of radiography and charted how the practice of radiography is changing as radiographers take on new and extended roles. A review of the literature has illuminated aspects of decision making and judgement. In the next chapter decision analysis will be discussed together with a review of its applications. Both this chapter and the one that follows put this study into context and prepare the reader to consider the research that has taken place in this study.

Chapter 2

Decision Analysis

2.1 Introduction

As noted in the chapter 1 decision analysis is a key feature of this study and is used as a research tool. Two of the primary research questions of this study are concerned with decision analysis: “Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?” and “Can decision analysis be used to investigate the relationship between judgement and decision making?” The process of decision analysis is discussed in this chapter. The chapter aims to review the literature relating to decision analysis and to introduce the reader to the process of undertaking a decision analysis.

Decision analysis is a systematic approach to structuring a decision, collecting relevant information about the probability and relative value of outcomes, and making quantitative recommendations (Birkmeyer and Welch 1997). It is a technique used to undertake decision making rationally and analytically in situations of uncertainty, and it offers a powerful technique which allows the decision maker to better understand and evaluate uncertain clinical situations (Tom & Schulman 1997). Decision analysis is based on Bayesian statistics (Lilford *et al* 1998). It is a systematic approach that allows different options to be assessed and is particularly useful when the decision is complex (Rascati 1998). Decision analysis is a form of “systems aided” (see section 1.2.1)

decision making. Watts (1989) states that Howard and Raiffa originally developed the technique at the Harvard Business School in 1968. Whatever its origins the technique is appearing in the medical literature with increasing frequency (Tom & Schulman 1997).

Detsky *et al* (1997a) argue that decision analysis is only appropriate when there is some uncertainty in the situation. There should also be a meaningful trade off in the problem i.e. one course of action should not dominate another because it results in lower rates of adverse disease outcomes and less risk of treatment side effects. If this necessary trade off is not present it is clear which action to choose and there is no decision to make. Eddy (1984) states that there is uncertainty in almost all aspects of the physicians work including, defining disease, making a diagnosis, selecting a procedure, observing outcomes, assessing probabilities, assigning preferences or putting it all together. Eddy is critical of medical practice, citing a number of medical disciplines that are adversely affected by uncertainty. Although medical ultrasound is not mentioned by Eddy he does state that the ambiguities grow worse as medical technology expands.

Moore and Thomas (1988) have stated that uncertainty is present in almost all problem situations and that it must be coped with. Where uncertainty can not be eliminated they advocate the use of "hard thought" in the form of decision analysis. Decision analysis is based on expected utility theory (Wu 1996). Dowie and Elstein (1988) explain expected utility theory as follows:

"The theoretical foundation of decision analysis is the theory of expected utility, a way of ordering preferences for actions that follow logically and coherently from a few axioms. Because expected utility theory has an axiomatic

base, it has a great appeal as the foundation for a rational theory of decision making and choice under uncertainty."

(pp16)

The axioms that expected utility follow are ordering, continuity, independence and transitivity (Wu 1996). Wu argues that building a theory on axioms has great merit and that this imposes a consistency between actual and hypothetical choices. Expected utility theory derives from the moral philosophy of utilitarianism developed by John Stuart Mill in 1863 (Barwise 1998).

It is not surprising, given its utilitarian foundations, that expected utility theory and decision analysis are discussed from an ethical perspective in the literature. There are ethical arguments for using expected utility theory and decision analysis in medicine (Dowie 1994). Schultz (1996) argues that "appropriately performed decision analysis is the embodiment of ethical behaviour – to not use decision analysis of some type is unethical". Schultz (1996) states that "applying decision analysis does not guarantee precision, but failure to use decision analysis of some type does raise the likelihood of mistakes substantially". It could be argued that if using decision analysis can reduce mistakes the technique can be considered ethical.

Douard (1996) states that the most important ethical consideration is that decision analysis makes explicit the roles of the patients' and physicians' preferences in making complex therapeutic decisions. In decision analysis the patient can be involved by giving personal values for health outcomes. Schultz (1996) argues that ethical decision analysis

recognises the duty of the professional to meet or exceed the reasonable expectations of the patient and society. One way of ensuring that the patient's expectations are identified is by using decision analysis. Bergus *et al* (1995) feel that ethically the fundamental goal of formal decision analysis principles is to assist the doctor in making the best decision. This view seems to ignore the role of the patient in decision making.

There are a number of papers in the literature that introduce the process of undertaking a decision analysis. (Rascati 1998, Keeney and Raiffa 1976, Weinstein *et al* 1980, French 1989, Sox *et al.* 1988). A thorough introduction to performing decision analysis is given in a series of articles produced by Detsky, Naglie, Krahn, Naimark, and Redelmeier in 1997. In this series of articles they give an account of how medical students at Toronto University are taught decision analysis. Decision analysis is made up of component processes (Rascati 1998, Keeney and Raiffa 1976, Weinstein *et al* 1980, French 1989, Sox *et al* 1988) these include: a) structuring the decision into choices, chances and outcomes, b) assessing uncertainties in the form of probabilities c) assessing outcome values in the form of utilities d) calculating expected utility and e) sensitivity analysis. Each of these stages will now be considered in relation to the published literature and a simple example given to illustrate the decision analysis method.

2.1.1 Structuring of the decision

Weinstein *et al* (1980) states that the first part of the decision analysis process is to break the problem down into its component parts. Those undertaking the decision must identify all possible alternative actions. A possible flaw in decision analysis can take place at the structuring stage if the decision maker does not identify all possible courses of action. Another potential problem in the structuring stage may be that too many possible courses of action are identified, which leads to a very complex decision analysis. This may seem to be a contradiction of the need to identify all courses of action but it is not. Limiting “environmental factors” must be considered when selecting the alternatives that are to be included in the analysis. Wroblewski (1995) illustrates this point in a paper that describes the application of decision analysis in a complex clinical case. The choice of treatment for an 85 year old woman with a breast lump and dementia was subjected to a decision analysis. The paper demonstrates how the many superfluous factors were eliminated as a result of the decision analysis but that all possible treatment alternatives were identified. As Detsky (1997a) put it “*A decision tree is not a complete representation of the real world it is a simplified and highly stylised model*” (pp24). The model must capture the key issues.

Detsky (1997b) gives six recommendations for those structuring a decision tree. These are:

- 1) The tree must have balance. This means that the tree must show the tradeoffs between risks and benefits. If one branch carries all the benefits and the other all the risks then a decision analysis is not needed.
- 2) Only two branches after each chance node. Detsky recommends this mainly to reduce problems with sensitivity analysis (see section 2.1.9). There is no problem in a decision analysis if there are more than two branches so long as the outcomes are mutually exclusive and exhaustive.
- 3) No embedded decision node. These are nodes that appear anywhere in the tree except at the left most position of the tree. Again there is nothing wrong with having an embedded decision node but they can lead to difficulty in interpreting sensitivity analysis.
- 4) The branches must be linked. Detsky defines linkages as “the explicit relationship(s) among probabilities and utilities in the various branches of the tree that ought to be related e.g. the probabilities of bad outcomes with and without treatment.” Probabilities of outcome should be linked with treatment effectiveness in the same manner on all branches. All branches should be linked by having similar outcomes by test characteristics and prevalence.
- 5) The tree must have symmetry. By this Detsky means “that all underlying initial health states that could affect outcomes are represented in all branches” (pp132). Once again Detsky states that this must be done to ensure ease of sensitivity analysis.
- 6) Do not worry about order. This simply means that the order in which the outcomes are listed on the tree do not effect the result of the outcomes.

It should be remembered that these are recommendations that are given to medical students when they are first introduced to decision analysis. Some of these recommendations are rules that should be followed for all decision trees (Recommendations 1, 4,5 and 6) while others (Recommendations 2 and 3) are included to simplify the process for those learning decision analyses.

Once all the possible courses of action are identified they can be shown graphically on a decision tree. Consider a very simple case where a patient presents with a set of signs and symptoms, which leads the doctor to two differential diagnoses:

- 1) the patient has X
- 2) the patient does not have X

In the health care system the doctor has two possible courses of action:

- 1) treat for X
- 2) do not treat for X

The partial decision tree for this situation is shown in Figure 2:

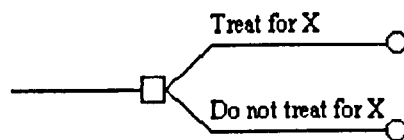


Figure 2. Decision tree to show decision node and branches

This simple tree is drawn using a computer program called DATA. The first node is square and represents a decision node. At this type of node the decision maker has to make a decision. Once this decision has been made what follows is the result of chance not under the control of the decision maker. This element of chance is represented by the circular nodes, which are chance nodes. The chance situations can also be modeled on the decision tree, in this simple case they are that the patient has X or does not have X. This is shown in Figure 3.

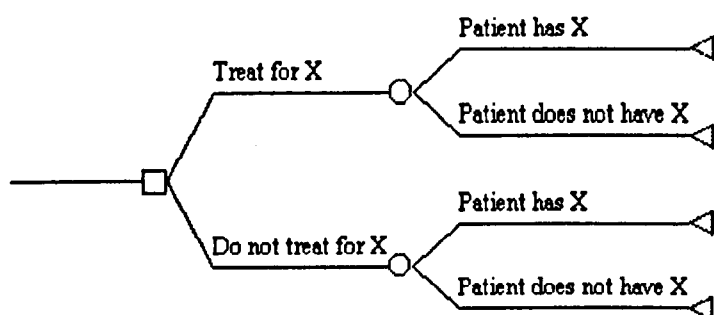


Figure 3. Decision tree to show chance nodes and branches

At the end of each chance branch another type of node is represented (in the case of DATA by a triangle, but in other systems by an oblong). This is a terminal or outcome node. This is an outcome of the decision. There are consequences associated with all the possible outcomes and these are shown in Figure 4.

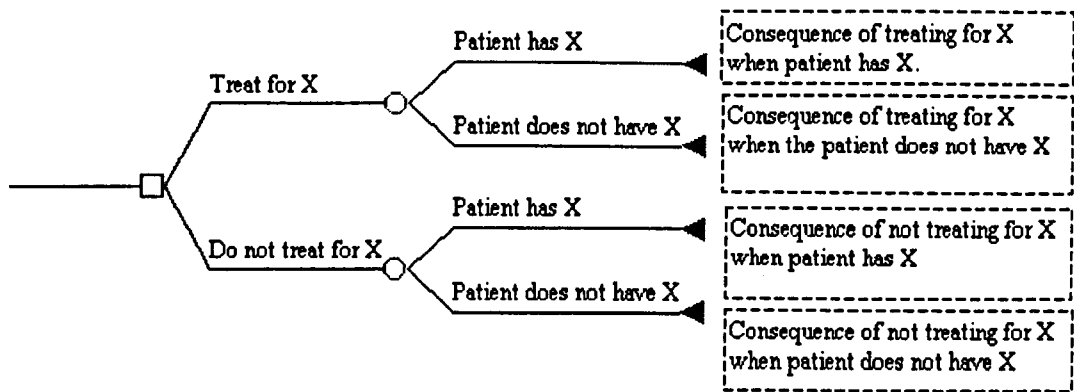


Figure 4 Decision tree to show terminal nodes and outcomes

The tree shown in Figure 4 is the most simple decision tree, but more complex trees can be drawn. These can include test branches.

Schultz (1996) suggests that “use of decision analysis need not be a rigorous mathematical exercise to be helpful in everyday clinical practice”. Simply structuring the decision can help people to structure their thinking (Phillips 1992). Even in the simple decision considered above it may be very difficult to consider intuitively all the possible courses of action and the possible consequences for taking them. The graphical representation clearly shows the decision maker the decision situation. This graphical representation may be particularly useful in medicine to help patients to understand relatively complex decisions with which they are faced.

Pauker *et al* (1976) identifies that there can be some over simplification in the structuring process. This could be seen as a positive aspect which helps to remove some of the complex superficial aspects of the problem, leaving the main issues of the

decision to be considered. Moskowitz *et al* (1984) has found that insights drawn from simple models are similar to those drawn from more complex models. The extra detail found in a complex model may well lead to confusion in some groups such as patients. The process of simplification may be particularly useful when the decision maker is faced with a “non routine” novel decision making scenario. The process of decision analysis may well help the decision maker to rationalise courses of action and uncertainty and to reject possible course of action which can graphically be seen to be non-feasible due to the environmental factors already considered. These non-feasible courses of action may well cloud intuitive decision making. It is however important that any simplification of the decision making is overt and acknowledged, in line with the idea that its explicit transparency is the key to the contribution that decision analysis can make.

2.1.2 Establishing levels of uncertainty

As already mentioned, decision analysis is a statistical method used to aid decision making in an environment of uncertainty. It therefore follows that a fundamental aspect of decision analysis is the assessment of chances. This is done by the addition of probabilities for the occurrence of each outcome that is included on the decision tree. Considering the simple example of a decision tree introduced earlier on in section 2.1.1 the probabilities are estimated and added as in Figure 5:

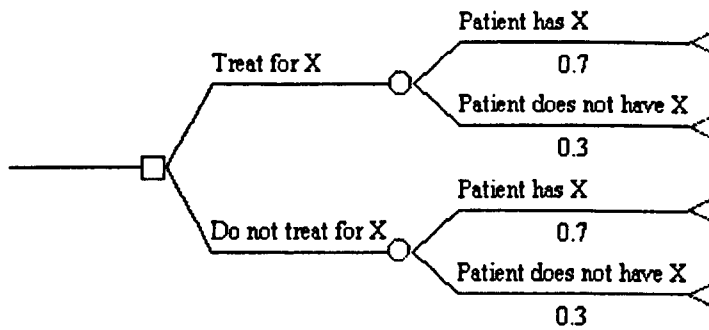


Figure 5 Decision tree with probability values added

In this case it can be seen that the chance of the patient having X is recorded as $p=0.7$ and the chance that the patient does not have X as $p=0.3$. The chances beyond any chance node must equate to unity. It is important to consider the source origin of these values for chance and ensure that the best available data available is used to estimate the probabilities (Wienstein and Fineberg 1980, Sox *et al* 1988 and Petitti 1994). This is one of the most complex issues concerned with decision analysis. Naglie *et al* (1997) states that probabilities should be obtained from what they call “good” published research. And that when good published studies are not available “expert judgement, existing databases and primary data collection should be used to estimate probabilities. Poses and Anthony (1991) and Bobbio *et al* (1992) state that this type of data is prone to bias and should be used with care. Because of this, Naglie *et al* (1997) recommends that when this type of data is used to estimate chance a wide range of possible values should be included in a sensitivity analysis.

From the decision analysis literature it becomes clear that the issue of estimating chance is one of the most poorly understood aspects of decision analysis. Tomassi (1995) states that traditionally there have been two approaches to probability: objective and subjective and goes on to show how the concept of objective probability as expounded by Bernoulli in 1713 and Laplace in 1820 was developed in the 1940s and 50s by Keynes and Carnap. It will be shown below that a subjectivist approach to probabilities is one that embraces both frequency and non-frequency based estimates of probabilities. Some papers (Corcoran 1986) classify the probabilities into subjective and objective probabilities. Although Naglie *et al* (1997) do not make this simple distinction between probabilities they do treat the probabilities acquired from “expert estimates” in a different manner to those obtained from frequency based studies. This approach will be reviewed followed by a rejection of this simplified dichotomy.

2.1.3 Objective and subjective probabilities.

Because the concept of objective and subjective probability is evident in the literature (Corcoran 1986) it is felt important to review this approach and make clear the author’s position. “Objective” probabilities are used when similar past events can be reviewed and the chances for various outcomes calculated as frequencies. In our simplified example there may have been many cases of people presenting with the symptoms common to this particular patient. The doctor could consult the medical literature and find examples of systematic study of this condition and may be able to find a quoted probability for patients who have these symptoms having condition X. This can be added to the decision tree. Writers (Corcoran 1986, Naglie *et al* 1997) who advocate the

use of this type of probability feel that the accuracy of the probability is increased with an improvement of data. This type of data can be generated because the event (in this case a patient presenting with these symptoms) can be repeatedly observed and studied in a scientific manner. In other words frequency data can be generated.

In many cases data can not be found because the event is unique or rare and can not be repeated to give objective probabilities. In these cases Naglie *et al* (1997) advocates the use of expert judgements, existing databases and primary data collection. When expert judgements are used a subjective estimate of probability must be made. Subjective probabilities are "qualifications of personal judgement, experience and expertise" (Lucey 1996). Subjective probabilities are often the only probability data available. This type of data is improved with the experience of the person making the estimate of the probability. One factor that does seem to contaminate the estimation of uncertainty by clinical decision makers is risk aversion (McNeil *et al*: 1978). Einhorn and Hogarth (1978) have shown that subjective assessments of probability are based on past experience and this may well include biased examples from the past.

Some writers have been concerned about the validity of this type of Bayesian approach when subjective probabilities have been used (Shafer 1976). Polister (1981) uses this as evidence to state that it is "difficult to represent beliefs about the likelihood of events with numbers, especially if the events are ill defined or unforeseeable". Yates and Zukowski (1975) are so concerned about the unreliability of subjective prior probabilities that they put forward a model that does not use them. This unease about subjective probabilities may be justified when Schulman *et al* (1992) work is considered.

This would suggest that the probability of an event is not a property of the event but of the estimator of the probability. Events and objects do not have probabilities as an aspect of their being; probabilities are external to them.

This view of probability would indicate that objective and subjective probabilities are the same thing. The only difference between objective and subjective probabilities is the amount and nature of the information that is known about a situation at any point in time. This notation also clearly shows that, as more information becomes available then the probability for the event changes.

In the simple decision tree considered earlier the doctor assigned a probability value of 0.7 for the patient having X. If the doctor received more information either in terms of reading further scientific papers about the condition, or more information from the patient then the probability of the patient having X will change.

The concepts of probability considered here form the basis for Bayes Theory, developed by The Reverend Thomas Bayes in the eighteenth-century. Lindley (1985) has stated that a more descriptive name for the theorem would be “inversion theorem” or “stand-on-your-head theorem”. In simple terms this can be considered to be “our view of the world changes as more information about it is gained”.

Lucey (1996) gives the notation of this as follows:

$$p(A|B) = \frac{p(A) \times p(B|A)}{p(B)}$$

Where A = event A
 B = event B
 p = probability

Dowie (1992a) has summarised the two different approaches to probability as follows:

“The alternative to their (probabilities) being properties of the external world is that they are expressions of the internal world of our minds. In this alternative subjectivist view, a probability is somebody’s assessment for an event happening or being the case, rather than a property of that event.”

There are a number of advantages to taking the subjectivist view of probability. It allows the probability of unique events to be considered whether or not “objective” frequency data can be collected through the observation of repeated events. There is however, a blurring between the subjectivists and the objectivist approach to probability (Fischhoff & Beyth-Marom 1983). Both groups would be willing to use data based on frequency count, but both groups would disagree about the nature of the probability value that was finally established. The objectivists who use purely frequency based values cannot talk about the frequency of a single event. This makes the objectivist approach of limited value in many decisions and judgements that concern unique events.

2.1.5 Qualitative estimates of probability

Before leaving the subject of assessing uncertainty it is worth considering how practitioners do this in practice. This section has only considered estimating probabilities using numbers. Words are also used to express estimates of chance. When people estimate the chance of events, terms such as “rarely”, “very likely” and “often” are used. The use of words to quantify chance is shown to be problematic by a number of studies (Dowie 1992a, Nakao and Axelrod 1983, Kong *et al* 1986). The main concern identified is that different people give different meaning to the same words. Dowie (1992a) calls this “Numerophobia” and in his study showed that health professionals estimated the word “rarely” to mean anything between 1% to 20% chance and the term “a real chance” between 1% and 99% chance. These differences in estimates were seen between health care professionals. Differences in estimates between health care professionals and their patients are demonstrated to be even higher in the Nakao & Axelrod study.

2.1.6 Application of utilities

The person undertaking the decision analysis must assign values to the possible outcomes of the decision. Naglie *et al* (1997) identifies several ways in which outcome values can be expressed including life years, quality adjusted life years (QALYs), cases of the disease or complications prevented or utilities. Utilities are expressed in relation to the best possible out come and worst – these are called the “anchor states” and are often death and full health. In some types of decision making the values can be monetary (Lucey1996). This approach is often used when a business decision analysis is being undertaken and the aim is to maximise profit. In some decision analyses a multi-utility

approach needs to be taken. In this approach there may be two or more dimensions to the utility value being set, for example when a particular medical outcome is valued together with the resource unit that is required to achieve that outcome.

All utility values for states of health are subjective in nature. The utility values are the values that people put on the various outcomes of the decisions and this can only be based on a subjective opinion of outcomes. The values for outcomes will vary from person to person. The acquisition of these values causes some problems for the decision maker. A number of tools have been developed to assist the decision maker. The concept of assigning numerical values to outcomes that are not normally associated with numbers is difficult for some practitioners and clients to accept. Polister (1981) sums this up as follows: "*difficulties in utility assessment may arise from the abstractedness of the techniques.*"

In the simplified example we have a range of possible outcomes which can be considered to be health states. Consider that the treatment of X involves the removal of a leg, and the non treatment of X means that the patient dies. The question that must be asked of the patient is what numerical values do they have for the following health states; a) healthy, b) having one leg, c) death, d) having one leg when there was no need to have the other leg removed.

Many of the techniques employed to assist the extraction of these values relate the issue to areas where the numbers are more readily accepted. Torrance (1986) identifies four ways of estimating utilities 1) arbitrarily assign values based on your judgement, 2) have

a group of experts reach a consensus on the estimates of utility value, 3) search for relevant published utility values in the literature, 4) measure the values directly in appropriate subjects using reliable and valid methods. One method to measure the values directly from subjects is the standard gamble method. This involves the numerical assessment of utility based on attitude towards risk. The standard gamble method relates the process to gambling. In an example given by Eddy (1984) women are asked to value the removal of a breast scar. The gamble method although effective does have a number of problems associated with it. The framing of the gamble question is very important. People often change their value judgements with a change in the frame of the question (Poulton 1968). Baron (1996) concludes that problems with standard gamble methods come about because of the way that we think about probabilities leading to inconsistent estimates of utilities of identical outcome. Barron (1994) has stated that other methods such as "difference measurement" may be better.

Most research in this area indicates that individuals have very different utilities for different actions and health states. For example in the breast scar study cited but using a "willingness to pay" approach women valued the removal of the scar from below \$1000 to over \$10,000. This would indicate that the utilities for the various health states must be elicited from the patient. In the example decision, the values for death, health and one leg must come from the patient. The doctor may put very different values on the health states. It has been found (Seckler *et al* 1991) that patients' family members and physicians can not accurately predict the wishes of the patient even when the patient predicts that they will be able to do so. Heckerling *et al* (1999) conducted research to see if the preferences of patients, agreed with a decision analysis. They undertook one

decision analysis using the utility values of the patient and the other using the values of the doctor. Not unsurprisingly they found that the decision analysis using the patients' values agreed with the patients' preferences for which test to use. They conclude that patient not physician preferences in decision models correspond to the choice made by the patients.

2.1.7 Calculating expected utility

The calculation of the expected utility is an important aspect of decision analysis. The synthesis of utilities and probabilities is an aspect of intuitive decision making, which is difficult for doctors to perform (Dawes 1979, Elstein 1978). The expected utility for each decision arm is calculated by multiplying the probability of each outcome by its value. The expected utility is not the utility of making the decision along that decision arm. The expected utility is a combination of both utility and probability. Most assume that it is rational to make the decision that gives the greatest expected utility. If the expected utility for any two decision arms are the greatest and equal then there is a 50:50 chance of gaining maximum utility on either decision arm so either decision can be made by the toss of a coin.

Using the simple decision analysis it is assumed that a patient has assigned the following utilities to the possible health states:

- a) healthy 100
- b) having one leg 70
- c) death. 0
- d) having one leg when there was no need to have it removed. 65

This can then be entered onto the decision tree. This is shown in Figure 6.

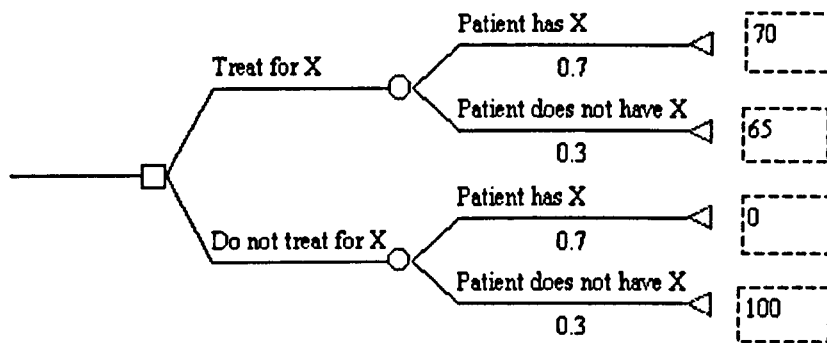


Figure 6. Decision tree with utility values added

The expected utility can now be calculated for each course of action:

$$\begin{aligned} \text{Expected utility for treating for X} &= (0.7 \times 70) + (0.3 \times 65) \\ &= 49 + 19.5 = 68.5 \end{aligned}$$

$$\begin{aligned} \text{Expected utility for not treating X} &= (0.7 \times 0) + (0.3 \times 100) \\ &= 0 + 30 = 30 \end{aligned}$$

In this example the expected utility for treating for X is higher than the expected utility for not treating for X. The patient should be treated for X if the patient and the doctor want to maximise expected utility.

2.1.8 Expected utility.

Simply because a good decision making process is followed and expected utility is maximised it does not mean that the outcome will always be good. It is often the case that the outcome with the lowest and highest rated utility is on the same arm of the decision tree. Because the technique is statistical and is concerned with probabilities there is always a chance that the worst outcome may result from the “rational decision”. It is possible to have a good decision making process but the worst possible outcome. An interesting example would be a decision to have minor plastic surgery on a condition such as a facial mole. The outcomes with the highest and lowest utility will occur on the same branch i.e. 1) perfect cosmetic result and health 2) death from a reaction from anaesthetic. After a careful decision analysis it is decided to have the operation due to this decision arm giving the highest expected utility. If death follows from anaesthetic then this would be an example of a good decision making process but the worst possible outcome. Probably people would not have a problem with this concept if it were realised that they make decisions under uncertainty many times each day that could result in catastrophic outcomes.

The definition of the term “good outcome” also needs some consideration. Practical problems of defining “good outcome” have been identified for example McNeil *et al*

(1978) demonstrates the over simplistic way in which five year survival rates have been used to define utility of outcome in cancer care. He points out that good outcomes are defined differently by patients and doctors. Doctors may see a five year survival rate as a "Good outcome" but the patient does not. Coombs (1972) indicates that this is a deficiency of utility theory. Coombs states that this deficiency can be traced back to the fact that utility approaches do not seem to fully capture the patients' feelings about risk taking. This may well be the case but this seems to be a deficiency in the person undertaking the analysis rather than the technique. If utility elicitation is undertaken correctly by the standard gamble method the patient's feelings regarding risk are included.

2.1.9 Sensitivity analysis.

There is a cross-over threshold for expected utility where the rationale course of action changes i.e. the branch with the highest expected utility changes. The results of a decision analysis can be tested to discover how sensitive the decision is to changes in the utility and probability value. This is a measure of the "robustness" of the decision. Changes are made to the value of a parameter to the point where the option identified as optimal by the decision analysis changes.

Hill (1986) states that "*a prudent decision maker will attempt to evaluate the consequences of uncertainty by performing a sensitivity analysis*"(pp140). They state that a sensitivity analysis can be used to measure the robustness of a decision. The analysis gives a measure of the degree to which probability or utility values must be

changed before the decision threshold is reached. The greater these values have to be changed – the more robust the decision.

It can be seen from the simple decision to treat or not for X the probability or utility values have to be changed by a considerable degree before the decision strategy changes. A sensitivity analysis on this example would demonstrate a robust decision. Sensitivity analysis can be undertaken using specialist computer software. This type of software calculates the threshold value at which point the decision changes. This data is often displayed graphically. An example of such a graph is shown in Figure 7 when the threshold value for the probability of abnormality is 0.769.

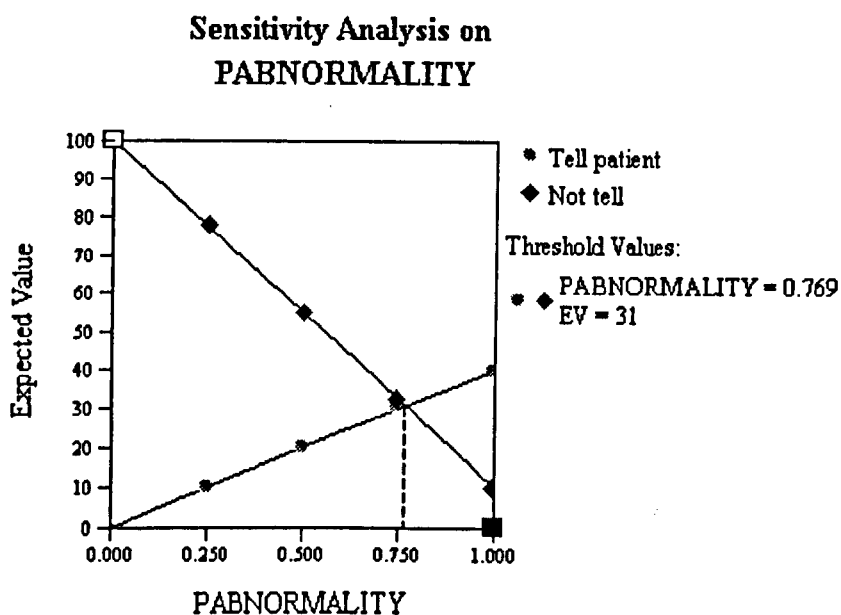


Figure 7 Example of computerised sensitivity graph.

When considering the parameter for a sensitivity analysis Naglie *et al* (1997) states that it is important to consider how the probability in the decision analysis was obtained. He

states that the best estimate of probability is called the base-line estimate. For example a published paper on the disease encountered in the example decision tree introduced in section 2.1.1 may state that a patient with these signs and symptoms has a 70% chance of having the disease. If this is the best source of information then the base line estimate is 70%. The uncertainty about the estimate of probability is called the range. Considering the example once more, the paper that gives the probability of 70% may also state that there is a + or - 5% chance that this value may be wrong. The less confidence in the estimate the greater the range. This range should be used in sensitivity analysis. The greater the chance that probability value may be wrong the greater this value should be changed in the sensitivity analysis. Hence in the example above sensitivity analysis should be undertaken for values of probability between 65% and 75%. This will establish if the decision remains unchanged or changes over the range.

2.2 Criticism of decision analysis

In the previous chapter (section 2.1) the disadvantages of analytical decision making were considered. Many of the criticisms of analytical decision making can be applied to decision making. Watts (1989) states that decision analysis is not a practical way of making most decisions in everyday clinical practice because it is too time consuming and should be used selectively. Decision analysis is not a substitute for other methods of decision making. Intuition judgements, use of theoretical models, knowledge - problem coupling and hypothesis orientated algorithms for doctors all provide important tools for improving patient care.

Kassirer *et al* (1987) states that “some clinicians and clinical epidemiologists question the precision of the data employed, the clinical appropriateness, physician and patient reactions and even the validity of the approach”. Decision analysis is a decision aid that aims to supply the decision maker with a formula which indicates the correct course of action to take. In relation to managerial decision making Adair (1985) indicates that he does not feel that decisions are of the nature where there is one correct answer. He states that:

“In many circumstances there is no one correct course of action: several paths lead to the top of the mountain. Here decision making contrasts sharply with mathematical problem solving; there is only one correct answer to the problem.”
(pp32)

This is an interesting statement to find in a book that claims it is a guide to thinking for management success. As with much of the decision making literature the process of decision making is considered but no decision aid is developed or advocated.

Moore and Thomas (1988) demonstrate how decision analysis can be applied to management. Their approach is contrasted with that of Adair:

Descriptive methods have been used, by social psychologists and other behaviorists, to evolve general theories of decision making through observation of how people currently make decisions.....our belief (is) that there is a positive contribution to be made by mathematicians and statisticians to the development of the subject -

not merely confirming managers in their present ways.

(pp2)

In their very practical book they go on to demonstrate decision analysis as a decision tool.

In his philosophical analysis of expected utility theory Cohen (1996) argues that expected utility theory is inappropriate for decisions that are made in medicine because they are one off decisions and that expectation is a long run property that applies to repetitive case. Wu (1996) has argued that Cohen's arguments are not strong enough to lead to the abandon expected utility theory – although he does concede that the theory does have limitations.

2.3 Applications of decision analysis

Birkmeyer and Welch (1997) have noted that decision analysis is appearing more often in the surgical literature. However, this growth in the use of decision analysis does not seem confined to the surgical literature because one can find examples of decision analysis being applied to almost every field of medicine. The growth in the use of decision analysis may be because in 1984 the Association of American Medical Colleges advocated that decision making be taught in all medical curriculums. There are departments of clinical decision making in the USA that use decision analysis as a routine aspect of clinical practice (Dowie 1992a). Dowie (1992a) notes that such a department is the Clinical Decision Making Unit at the New England Medical Center in

Boston Massachusetts. The supporters of analytical decision making are evangelical and some have likened the development of decision analysis to a religious process that is being developed (Tarlov 1990).

Although there is a growth in the use of decision analysis there are health care professionals who are reluctant to use such techniques. Schmit, Norman and Boshuizen (1990) conclude that doctors are not comfortable using numbers to the exclusion of intuitive judgement. Schultz (1996) states:

“The idea of using mathematical models to determine what is next clinically is inherently unpopular in the “trenches”, and it is probably untenable as the sole basis for decision making in the clinical area (i.e. replacing intuitive decision making). Along the way decision analysis as an adjunct for deciding the next move has acquired a bad reputation. This prejudice is probably based on ignorance of the intent of decision analysis and periodic experiences of an inappropriate application of decision analysis concepts as cost saving strategies within certain care organisations “

Dolan (1997) suggests there is a slow acceptance of decision analysis. He surveyed 46 hospital doctors and found that 48% of them clearly understood decision analysis, 28% of them reported that they felt the technique could be helpful in clinical practice. However 87% said access to latest research would be more helpful. These doctors ranked access to decision analysis as the lowest intervention while access to a published research article was the highest. This indicates that even where doctors understand the process of decision analysis they feel that access to research findings is more important.

This reluctance should be noted but should not distract from the fact that the use of decision analysis is growing. Decision analysis has not only been used as a decision aid it has also been used to formulate policy and more recently to fill the research/practice gap and hence implement evidence-based practice. The following sections review the literature with regard to decision analysis being used as a decision aid, as a tool for policy formation and finally for the introduction of evidence based practice.

2.3.1 Decision analysis as a decision aid

Jerome *et al* (1987) reviewed 191 papers that utilised decision analysis. In this review the authors consider a number of areas where decision analysis has been applied within medicine and these include; Solitary Thyroid Nodes, Hodgkin's Disease, Pregnancy, Genetic Counselling, Vaccination, Asymptomatic Gallstones, Non-invasive testing for coronary artery disease and coronary artery bypass surgery.

Since 1987 there have been many more examples of decision analysis being used. Decaecanter *et al* (1997) for example has shown how decision trees are a useful tool for identifying specific diagnostic and prognostic markers in various types of tumour pathologies. Brundage *et al* (1997) give an account of how decision analysis can be used to select the optimal management of non-small-cell lung cancer. They used patients' values and concluded that more needs to be done to identify the health states critical to the condition and valid measurements of the utility for these health states. Olson *et al* (1998) has used decision analysis to evaluate the role of ultrasound investigation in the

diagnosis of pyloric stenosis. They found that ultrasound was not the optimal technique to use.

Within the field of nursing intuitive notions of practice have dominated. Benner *et al* (1984, 1999) has advocated these very strongly. In Benner's model of nursing practice analytical decision making has been considered to be the province of learner and novice nurses. It is thought that the dominance of this style of thinking has led to relatively little literature being published on decision analysis within nursing in relation to the size of the profession (Panniers and Kellogg Walker 1994). However, because the profession is so large there is still considerably more literature applying decision analysis to nursing than to any of the other health professions other than medicine.

Within nursing there have been studies to compare analytical decision making to intuitive decision making (Hammond *et al* 1967, Grier 1976, Aspinall 1979). Hammond's study compares nurses' decision making with that of a Bayesian model and Grier's compares intuitive decisions made by nurses to those made by a utility model.

Aspinall (1979) demonstrates clearly how decision analysis can be used to improve the diagnostic accuracy of nurses. The results of the study are well presented but limited. There were three groups of nurses. Group one was given a case study; Group two a case study plus a list of possible diagnosis and; Group three the case study, the list and a decision tree drawn by experts. The third group out performed the other two groups in coming to the gold standard decision. The study may have been of more value if the third group had been taught the process of decision analysis and been required to

undertake a decision analysis regarding the case study. If an expert decision analysis is to be used then it may be simpler to develop this into a clinical protocol rather than have individual practitioners use it. The impact on nurses' clinical intervention decision making was considered by Shamian (1991). This study involved student nurses and found that a group of 37 student nurses who were taught decision analysis for four hours out performed a group of 31 student nurses who had not been taught decision analysis. The performance was judged on how well the students agreed with expert decision making. The results indicate that decision analysis can improve decision making.

A study by Baumann and Deber (1989) demonstrated decision analysis was inappropriate for nurses because they found it impossible to agree on a set of nursing actions which were needed to care for a critically ill patient. This finding was refuted by a study undertaken by Panniers and Kellogg Walker (1994) who found that nurses could undertake such a task. This study concludes that decision analysis can be used to quantify intuitive choices, document them and incorporate them into clinical practice. Fowler (1989) however, considers contemporary nursing ethics education focuses on the use of an analytical model of ethical decision making for both its process and content.

Outside of medicine and nursing there are a number of papers in professional journals that demonstrate how decision analysis could be used in particular professions, but few examples of how the technique has been used. There does seem to have been some interest in the field of Physiotherapy. Watts (1989) feels that the techniques could be applied to physical therapy practice particularly where decisions are complex, made frequently, have important consequences, provoke some sort of significant controversy,

uncertainty or discontent with the results of less formal decision making achieves. In her paper she gives an example of a complex decision analysis concerning the siting of a clinical service. She feels that more decision analysis within the field of physical therapy will enrich and enliven the practice.

In the field of pharmacy there have been a number of papers (Schumacher and Barr 1995, Barr and Schumacher 1991) which have demonstrated how decision analysis can be used in clinical decision making. Mutnick and Szymusiak-Mutnick (1996) illustrate how decision analysis can be used to develop policy. In this study they report on how a decision analysis can be used to develop a policy for the treatment of chemotherapy induced nausea and vomiting. This study concentrates on cost effectiveness and is used to choose the most cost effective agent in the treatment of chemotherapy induced.

2.3.2 Decision analysis in the development of policy

Decision analysis can be used to provide information when developing policies about the management of groups of patients (Petitti 1994). The use of decision analysis in this manner in pharmacy practice is seen in Calvo *et al* (1990), Barriere (1991) and Carr and Walker (1997). The use of decision analysis to formulate policy is very closely related to its use as a decision aid. The fundamental difference being that when used as a decision aid the technique is used to determine a course of action for a specific patient and when used to formulate policy it is used to decide a course of action for a group of patients. Because the formulated policy is not specific to a particular patient group utilities have to be determined. Another difference between decision analysis as a decision aid and its

use in policy formation is the policy is often used widely by people who were not involved in the formulation of the policy and may not even be of the same professional group. An example of such a situation would be where a doctor formulated a policy using decision analysis and this policy was enacted by a group of nurses.

Mutnick and Szymusiak (1996) have shown how decision analysis can be used to formulate locally derived clinical guidelines. In their study they used decision analysis to choose the most cost-effective agent for the treatment of chemotherapy-induced nausea and vomiting. Their study employed decision analysis as a tool to graphically illustrate "cost effectiveness choices". They used monetary values for utilities. They conclude that decision analysis is a useful tool for developing guidelines. The formulation of policy (in the form of guidelines) was made easier in this case because the utilities were in the form of monetary values. The formulation would have been more problematic if the utility values were in the form of subjective patient values of health states.

Studies have been undertaken using decision analysis to evaluate policies that are already in place (Romano and Waitzman 1998, Buskens *et al* 1997). A study carried out by Romano and Waitzman (1998) considered the worth of ultrasound screening for foetal abnormalities. Their study used standard gamble, willingness to pay and human capital estimates to estimate utility of outcome. The study found that the policy of routine scanning was the optimal strategy for most women. The study by Buskins *et al* (1997) also investigated foetal ultrasound screening with particular regard to congenital heart disease. They applied decision analysis to establish that the policy of routine screening for congenital heart disease had relatively little impact.

Fletcher *et al* (1995) have used decision analysis to compare policies for the antenatal screening of Down's syndrome, comparing six different screening policies. The analysis found that the optimum policy was a serum test for women over 30 years of age. They state that there are number of benefits to using a decision analytic approach these including: a) all outcomes can be considered in relation to the local population, b) details of the local population can be included, c) allows the population consequences to be communicated in such a way that the debate that followed focused on outcomes.

From the preceding accounts it can be seen that decision analysis does have a role to play in the formulation, evaluation and comparison of policies.

2.3.3 Decision analysis in the introduction of evidence based practice.

Richardson *et al* (1995a and 1995b) show how decision analysis can be used in the implementation of evidence based practice. With the development of "evidence based practice" there is a growing awareness that practice must be based on research and evidence to ensure that clinical practice has proven effectiveness (Evidence -based Medicine Working Group 1992, Davidoff *et al* 1995, Rosenberg 1995).

Decision analysis can be used to implement research findings. Dowie (1996a) describes a research-practice gap which leads to "even methodologically sound findings that have clear implications for practice and patients, are reflected belatedly, and sometimes not at all, in the behaviour of many health care professionals"(pp1). Dowie (1996b) argues that

decision analysis is the best form of systems-aided approach to bridge the gap. Lilford *et al* (1998) argue in a similar manner to Dowie in a paper which demonstrates how decision analysis can be used in the implementation of research findings.

Dowie (1996b) puts forward a radical argument that there needs to be a paradigm shift within medicine which entails the introduction of “*decision analysis based medical decision making (DABMDM)*”. He asserts the duality of medicine, which identifies two distinct aspects of medicine, the making of decisions and the carrying out of actions. Dowie argues strongly that the medical profession cannot move towards the introduction of evidence based and cost effective and preference based medical practice until DABMDM is adopted. In his paper Dowie thus moves on from proposing that decision analysis should be used to address the research-practice gap to a proposal that decision analysis becomes the basis for most medical practice.

Considering the widespread use of decision analysis as a decision aid and the growing importance of decision analysis as a method for introducing evidence based practice it is surprising that there is not more interest in decision analysis as a research tool. Clemen (1996) claims that decision analysis can be used to “gain insight” this would indicate that decision analysis could be a valuable research tool. In the research used for this study extensive use was made of decision analysis as a research tool.

Mary and Nettleman (1989) argue that doctors rely on clinical trials to get information regarding new products. These trials are rarely undertaken in the patient population that they work with. They argue that decision analysis is a method for integrating the results

of clinical trials with data regarding their own patient populations. Sackett (1991) also notes that the results of trials and research do not always match the population that the clinician is working with.

2.4 Conclusion

This chapter has introduced the reader to decision analysis, by discussing each stage of an analysis. Issues and controversies such as the philosophical approaches to probability have been noted. It has been shown that there is a growth in the application of this technique within the health professions. Although decision analysis was originally devised as a tool to aid decision making it has been shown that it has also been used to develop policies and protocols and more recently to implement research findings. It is clear from the discussion in this chapter that decision analysis has a lot to offer health care professionals.

In the following chapters the author will describe and discuss how decision analysis was used in this study. It will be argued that decision analysis has yet another application – that of a research tool. By being fully conversant with the material in this chapter the reader is well prepared for the chapters that follow.

Chapter 3

Methodology

3.0 Introduction

This chapter will review the choice of methodology and data collection techniques used in this study. The exact details of how data was collected using these techniques is included in the following chapters.

The rationale for this study and the motivation for the selection of the research questions are discussed in chapter 1 section 1.1. The main driving force for this study was the researcher's interest in both radiography and decision making. The researcher used knowledge gained from teaching decision making and judgement to look critically at radiography. The researcher became aware that very little was known about decision making and judgement in the context of radiography. After reflection on the techniques used in the study of decision making and judgement he also became aware that decision analysis could be used as a tool to gather data to learn more about radiography. From this critical and reflective thinking the following research questions were formulated:

- 1) What is the scope and nature of clinical judgements and decisions in radiography?
- 2) How are these judgements and decisions made in radiography?
- 3) What is the relationship between judgements and decisions made in radiography/
- 4) Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?

In the context of this research “scope” of decision making relates to the type of decision that is being made and the “nature” pertains to the inputs, processes and outcomes of decision making and judgement.

3.1 Guiding paradigms

There are a number of approaches to research and in the right context any of them can generate important knowledge (Harper and Hartman 1997). These approaches or philosophical viewpoints are often called paradigms. Harper and Hartman (1997) identify three research paradigms: positivism; interpretivism; and; critical social theory. Once the research questions were formulated the researcher made a number of decisions regarding the paradigm to use to guide the present study. The main factor in deciding the most appropriate paradigm to use is the research question, given the dictum that the problem under investigation always dictates the method of investigation. It is important that the research method used is appropriate to the question. All research methods have limitations but these can be reduced if there is a match between question and method. On considering the various paradigms and reflecting on them the researcher also became aware that his own experience and past experience had an impact on his approach to the study.

The positivist paradigm demands that the researcher adopts an objective and detached stand, and that there is an objective reality that is open to observation and measurement (Newman 1992). This paradigm has been one most prevalent in the development of radiography because of its physics and biology base. This is also a paradigm that has influenced previous research by the researcher. On reflection this approach did not seem wholly appropriate to the research questions. A positivist

approach could go some way to answering some of the questions but the researcher came to the conclusion that this approach would not answer the questions fully. This was mainly because the researcher felt that the research questions were centred about clinical decision making and judgement. Clinical judgement and decision making involves the one-on-one interaction between two people (Dowie 1992b) in the context of this research a patient and a radiographer. The researcher decided that the experiences and perceptions of these two people are important and worthy of consideration. The positivist paradigm did not fit well with this type of data collection. Silva (1977) notes that positivist research often sacrifices meaningfulness for rigor and Harper and Hartman (1997: pp30) states that “positivist science was seen to be limited in its capacity to illuminate information of significance to the phenomenon of caring”. It should be noted that although the positivist paradigm was not the major guiding paradigm for this study it did, however, have some influence.

The researcher became aware that the interpretative paradigm also called qualitative, phenomenological and non-positivism (Ellis and Crookes 1998) better fitted the questions under consideration. The interpretative is “*based on the premise that that reality is constructed and is socially and culturally based*” (Harper and Hartman 1997 pp30). This approach fitted very closely with the researcher’s understanding of radiography practice. For him radiography is made up of the perceptions of patients, radiographers and other health care professionals. The researcher’s perception of radiography fitted closely with Lowenburg’s view that within the interpretative paradigm “*reality is seen as constantly buzzing chaos that must be interpreted cognitively, rather than an objective reality waiting to be discovered*” (1993 pp58). Rather than testing theories the interpretative paradigm sets out to generate theory

from the study (Vaughan 1992). This seemed to fit the field of radiography where there is very little theory. The researcher's subjective involvement is encouraged and the researcher's interpretation of the data is seen as important. " Harper and Hartman (1997) state:

"The eventual interpretation of meaning is a synthesis of the process between the researcher and the research subject. This acknowledges that data will be processed through the researcher's unique frame of reference and will therefore represent a unification of meaning between the researcher and research subject. This represents a fundamental difference from the role of the researcher as envisaged by the philosophy of positivism."

(pp31)

The researcher was attracted to a statement by Ellis and Crookes (1998) "unlike positivists, researchers in the naturalistic (interpretative) paradigm operate from the fundamental belief that humans need to know far more about themselves and the world in which they live, than can be "measured" objectively" (pp89). The author agreed with this statement and felt that the research questions could not be answered by objective measurements. He felt that to fully address the research questions the study must explore and investigate radiographers experiences and perceptions of making decisions and judgements.

On considering critical social theory the researcher found that this paradigm did have some resonance with the research questions under consideration. Critical social theory integrates subjective forms of knowledge such as human perceptions and experiences with objective observations (Campbell and Bunting 1991). Ellis and Crookes (1998) note that critical social theory differs from positivist and interpretative paradigms in two respects, firstly the purpose of the study and secondly

the role of the researcher in achieving that purpose. Critical social theory's purpose is about change. Harper and Hartman (1997) state:

“Critical theory, like feminist theory, demands that knowledge should be used for emancipatory social and political aims. Critical theory believes that one of the prime purposes of theory making and of research is to analyse the difference between the actual and the possible”

(pp37)

According to Ellis and Crookes (1998) the role of the researcher is as a change agent. A major aspect of this type of research is the empowerment of subjects through their participation in the research process (Hart 1995). In chapter 1 section 1.3.1 the relationship between radiographers and radiologists is discussed. This discussion demonstrates that there is an imbalance between radiologists and radiographers. The author felt that imbalance in power should be addressed. Although this paradigm was not the major guiding paradigm of this study the researcher does identify with this paradigm and does acknowledge that it may have had some influence on the development of the study. If this paradigm had been adopted the study would have become “action research”.

The paradigm that had the greatest impact on this study is that of interpretivism. It should however be noted that both positivism and critical social theory have influenced this study to some extent. This is at odds with the Nolan and Lundh (1998) who state that “clearly it is not possible to believe in more than one paradigm, as each is based on differing beliefs about the nature of the world” (pp4). After critical reflection the researcher feels that all research paradigms have something to offer in terms of addressing the research questions set, but the main guiding paradigm is interpretivism.

3.2 Research methods

While the interpretative paradigm is the guiding paradigm for this study there are a number of methodological divisions within this including phenomenology, ethnography and grounded theory (Lowenburg 1993). The author, reviewed these methodological divisions with the purpose of establishing which one would best fit the research questions. After critically thinking about these divisions he decided to use a phenomenological approach to investigate the research questions.

The German philosophers Husserl (1859-1938) and Heidegger (1889-1976) developed phenomenology. Phenomenological approaches study experiences from the perspective of those living those experiences (DePoy and Gatlin 1994). The aim of the phenomenological researcher is to study and present the perceptions of participant's experiences (Hallett 1995). Stephenson and Corben (1997) see phenomenology as

“a way of looking closely at seemingly ordinary, everyday experiences in order to ‘taste’ and ‘feel’ another person’s frame of reference and to see the world through that person’s eyes”

(pp115)

Stephenson and Corben (1997) identify the main features of phenomenology as being, firstly, that it is anchored in experience not theory, and, secondly, that its concern is to understand the way people exist in the world, the significance of everyday things and events and the phenomenon ‘as it is’, the lived event.

This approach appealed to the researcher, because he felt that if this level of understanding of people's perceptions of making decisions and judgements in the context of radiography could be established a great deal would have been learnt. The researcher was also drawn to this approach because phenomenologists make their participants actively involved in the research as co-researchers rather than seeing them as subjects (Stephenson and Corben 1997). The idea of working together to learn about this subject was appealing.

3.3 Data collection

Once the interpretative paradigm and phenomenological approach had been chosen the next stage of designing the study involved choosing the research data collection techniques to fit the research question. Stephenson and Corben (1997) note that the methods of data collection used in phenomenology are observation, unstructured interviews and diaries. In this study all these methods were used. Where this study differs in relation to traditional phenomenology is that a small survey was conducted initially and decision analysis was used to give structure to the interviews. The data obtained from the initial survey guided the researcher when undertaking the observations and interviews. By using decision analysis to structure the interviews the research question "Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?" was addressed. Decision analysis was also used in an attempt to make overt some of the intuitive aspects of radiographic decision making. By doing this it was hoped to understand the participants experience of making decisions and judgements. It is not thought that

the survey distracted from the phenomenological base of this study. It is also thought that the use of decision analysis enhanced the phenomenological base of the study.

To investigate the research questions it was decided to break the study up into three distinct stages. The stages of the research are shown in table 1. Table 1 also shows the primary question that was addressed at each stage of the research and also the method used.

| Stage | Nature of investigation | Research question | Method | Impact on next stage of research |
|-------|---|--|------------------------------------|---|
| 1 | Investigate radiographer's and sonographer's perceptions of their professional decision making and judgement. | What is the scope and nature of clinical judgements and decisions in radiography? | Survey questionnaire | Gave guidance to observations |
| 2 | Investigate and classify decisions and judgements made by radiographers and sonographers. | What is the scope and nature of clinical judgements and decisions in radiography? How are these judgements and decisions made in radiography? | Observation | Allowed a particular area of professional practice to be chosen for the focus of the next stage of the study. |
| 3 | Investigate one area of decision making and judgement within the chosen area. | Can decision analysis be useful in investigating judgement and decision making within professional practice? What is the relationship between judgements and decisions made in radiography? | Interviews using decision analysis | |

Table 1 Stages of research.

3.3.1 Stage 1: Small-scale survey

During the first stage of the study a small-scale survey of radiographers and sonographers was conducted to establish some of their perceptions of decision and judgement making. This survey did not provide extensive data but it did begin to

address the first two research questions and more importantly began to give the researcher a “feel” for the area under investigation. Full details and findings from the survey are discussed in chapter 5.

Questionnaires can be used to give a picture of surface elements (Edwards and Talbot 1994). The survey in this study was used to collect general data to establish whether radiographers and sonographers perceived that they made decisions and judgements, the range of decisions made, the context in which they were made and how, as professionals, they felt about these decisions and judgements.

Polgar and Thomas (1994) state that there are five steps to constructing a questionnaire: defining the information required; drafting the questionnaire; piloting the questionnaire; redrafting the questionnaire and finally administering the questionnaire. The administration of the survey questionnaire used in this study is discussed in Chapter 5. The questionnaire that was finally used is shown in Appendix 1. It will be seen from this that a closed style of question was used. This style of question was used because it produced the type of simple data required at the initial stage of the study. The data produced by this style of questionnaire was also easy to encode. The questionnaire was formulated so that it was easy to complete hence, it was hoped that the response rate would be high.

3.3.2 Stage 2: Observations

During stage 2 of the study, observation was used to obtain in-depth data about the scope and nature decisions and judgements made by radiographers and sonographers. Observation is an established method of data collection in phenomenological research.

Grbich (1999) notes three types of observational study: controlled observation; naturalistic observation and participant observation. Controlled observation is a method used in experimental research, it is undertaken in carefully controlled conditions. Although none of the variables present are manipulated, great care is taken to ensure that no variable changes between observations. Controlled observation is more applicable to a positivist study than to a phenomenological one. Naturalistic observation, involves observation of participants in their natural environment and is an accepted form of phenomenological method. One problem with this type of observation is that the presence of an observer can have an effect on what is being observed. The final category of observation is that of participant observation where the observer becomes part of the group being observed. By becoming part of the group, the impact of the observer on what is being observed is reduced. Participant observation is a widely used form of observation, particularly with ethnomethodology, phenomenology and symbolic interactionism (Grbich 1999).

In the present study observations were made of radiographers and sonographers. The execution of these observations is discussed in Chapter 5. These observations could be considered to be naturalistic because they took place in the natural work

environment. The people who were observed during this study were aware the observations were being made. Moreover because the observer was a radiographer he was perhaps accepted by those observed more readily than a non-radiographer would have been.

The relationship between the observed and the observer can be put into context by considering the roles that the researcher can adopt. Gans (1982) states that there are three possible roles; a) the total participant, b) the participant-researcher/researcher - participant and c) the total researcher. With the radiographers the author was closer to the participant-researcher/researcher -participant while with the sonographers he was closer to the total researcher. Polgar and Thomas (1994) however, states that there are four roles that can be taken by the researcher these are 1) complete participant 2) participant as observer 3) observer as participant and 4) complete observer. Using Polgar's classification the role taken by the researcher in the observational stage of this study would be "observer as participant". Polgar states in this form of observation there "is pretence of participation but there is interaction with other participants". This is further discussed in chapter 5.

3.3.3 Stage 3: Interviews

In-depth interviews formed an important part of this study. These included interviews with key informants from the ultrasound profession, sonographers and a patient. All interviews used decision analysis to elicit data. The interviews with the policy makers and the second round of the interviews with the sonographers were more

structured than the first round of interviews with the sonographers and the patient. The interviews and the findings from them are discussed in detail in chapters 6,7,8,9,10 and 11.

After critically reflecting on the data provided by the first two stages of the research a decision was made to focus the research down to one particular area of decision making and judgement in the third and final stage. The area chosen was the breaking of bad news within ultrasound practice. This decision is discussed in chapter 5 section 5.10. In turn it was decided to break this stage down into three sections:

Section 1 Interviews with policy makers;

Section 2 Interview with sonographers and a patient;

Section 3 Interviews with sonographers to establish how judgements relate to decisions.

The interviews were conducted to acquire data to answer the second research question "How are clinical judgements and decisions made?" A small group of sonographers and a patient were interviewed. The results from these interviews led to two further interviews which investigated how the sonographer's judgements "mapped" onto the decisions that they made and hence address the research question: "What is the relationship between judgements and decisions made in radiography could be directly addressed". These three sections are shown in the Table 2.

| Section | Research question | Method | Impact on following section |
|---------|--|---|--|
| 1 | <p>How are these judgements and decisions made in radiography?</p> <p>Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?</p> | Interviews with key informants from the ultrasound profession | Established that decision analysis could be used to structure research interviews in this field. |
| 2 | <p>How are these judgements and decisions made in radiography?</p> <p>Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?</p> | Round 1 of in-depth interviews using decision analysis | Identified that the link between decision making and judgement needed to be investigated. |
| 3 | <p>How are these judgements and decisions made in radiography?</p> <p>Can decision analysis be used to investigate the relationship between judgement and decision making?</p> | Round 2 of in-depth interviews using decision analysis. | |

Table 2. Sections of stage 3 of the research

For each of these sections, in-depth interviews were used, which took place over the course of a whole day. Decision analysis was used in all of them to structure the interviews. In sections 2 and 3, a computer program was also used to graphically model the decision making process as the decision was talked through.

The term interview has many meanings. Massarik (1981) lists six types of interviews, hostile interviews; survey interviews; rapport interviews; asymmetrical trust interviews; depth interviews and phenomenological interviews. **Hostile interviews** are interrogations. The interviewer has different objectives to the subject and the subject is attempting to hold back information. This type of interview was not relevant to this study. **Survey interviews** are a verbal questionnaire. People are asked simple questions and there is little interaction between the interviewer and the subject. This type of interview would fulfil the same purpose as the survey conducted in the first stage of this study. In **rapport interviews** the boundaries for the interview are clearly set. The objectives for the interview are made overt and both the interviewer and the subject seek to meet these objectives. There is a great amount of interchange and interaction between the interviewer and the subject. Over the course of the interview rapport develops between the two parties. In **asymmetrical trust interviews** one party has much more trust in the other. This usually comes about because one of the parties in the interview has much greater knowledge and skill. An example of such an interview would be between a patient and a doctor. **Depth interviews** tend to be long interviews where a level of trust is developed between the interviewee and the subject. Rapport is developed between the two parties. These interviews are used in research to determine relationships and motivations. **Phenomenological interviews** are very open interviews with few boundaries. They

tend to be unstructured and open ended. The nature of the interview often depends on trust and caring.

The interviews used in this study do not fit neatly into any one of these classifications. They were a mix of rapport, depth and phenomenological. The interviews certainly went in-depth and rapport did develop between the researcher and the participant. This was enhanced because of the use of decision analysis. This technique had to be learnt by the participants so there was a teaching dialogue in the interviews. The objectives of the interviews were phenomenological in nature, i.e. the researcher was seeking in-depth information about participant's experiences of making judgements and decisions.

3.4 The use of decision analysis

Decision analysis is of critical importance to this study. One of the main aims of this study was to establish if decision analysis could be used as a research tool. The process of decision analysis is discussed in chapter 2. The use of decision analysis and the conclusions drawn are included in chapter 7 and 8.

The aim of this section is to demonstrate how the use of decision analysis is related to the research questions. The second research question "How are clinical decisions made by radiographers?" suggests a research method which will make overt the processes that are taking place in clinical decision making. Due to his experience of using decision analysis the author decided to use decision analysis as a research tool. It was hoped that decision analysis would overcome some of the problems that are

associated with asking people directly about their decision making processes. Argyris (1976) noted that often when people are asked about their decision making processes, they state their objectives, assumptions and values rather than their actual decision making theories or guides. This can be because firstly problems with remembering, secondly reconstructing using models that they usually used or were expected to use rather than ones that they did use, and thirdly rationalising and creating logical story rather than stating what actually happened.

Decision analyses was used in all interviews based on scenarios involving hypothetical patients. In decision making research these are often called “*paper patients*” (Dowie 1992 pp49). It should be noted that the problems of using “*paper patients*” have been noted (Wigton 1986). Wigton’s main concern is that the information gained from a “*paper patient*” is not given the same weighting as that gained from a clinical patient. Others (Elstein *et al* 1978) have stated their unease at the use of simulations in research due to the lack of clinical fidelity. That being said the use of “*paper patients*” is very similar to the established research technique of using simulations in the form of scenarios that are put to subjects. Radwin (1995) has identified the following advantages of such research: variables can be easily controlled, operational definitions of concepts such as cues and hypotheses are more easily devised, measurement of subject response is eased and a “correct” decision is more easily stipulated.

By using decision analysis the research question could be better addressed. Decision analysis is not however an established tool so by using it in this study the research question pertaining to decision analysis could be addressed. It can be seen that the

answer to this question would be established if decision analysis could be used as a research tool. If the answer to this research question was negative then this would not be an appropriate way to investigate the other research questions.

3.5 Reflexivity

The act of selecting a methodology and appropriate techniques does involve choice and the researcher's own opinions and biases influence these. This in turn influences the direction of the research. There is no such thing as value free research. Myrdal (1970) has challenged the concept of objective value free research, believing that researchers are deceiving themselves if they believe that they are not aiming for conclusions that fit certain prejudices. Myrdal goes on to state that social research is a procedure for documenting versions of reality. Within the social sciences, objectivity has come to be viewed with some suspicion (Goulder 1970). Phillips (1990) argues that in qualitative research, researchers should expose their predisposition and biases as a requisite to the research and thereby allow the consumers of the research to judge its value. Grumet (1990) argues that terms such as validity and reliability should be abandoned altogether and social research should be seen as a literacy art.

Kellehear (1993) sees objectivity validity and generalisability as dubious in qualitative research and belonging to empiricist discourses. Post-modern/poststructural thinkers are critical of constructs such as objectivity, validity and generalisability preferring the concept of "reflective subjectivity" (Grbich 1999). Reflexivity is the process of identifying ones own beliefs and how these have been

socially formed. It also involves reflecting on how these beliefs impact on the research that is being undertaken. Marcus (1994) has identified four types of reflexivity: 1) self critique based on experience and empathy, 2) self critique designed to maintain objectivity, 3) reflexivity as location, emphasising diversity and intertextuality, 4) feminist, subjectivist reflexivity, situated in epistemological positioning.

Within phenomenology there is some debate about the issue of “bracketing”. Bracketing is a process of the researcher becoming aware of their preconceived ideas and biases and putting these aside when undertaking research. Some have argued that this is not possible (Minichiello *et al* 1999). However if researchers inform their readers of their interests and experiences it allows the reader to take these into account when evaluating the research (Gubrium and Holstein 1997).

3.5.1 Reflexivity statement

In this section I intend to make a statement of my background and my approach to research. This section is written in the first person. By doing this I will expose a number of my beliefs and allow the reader to judge how these may have impacted on this research study.

I am a radiographer by profession. This discipline is scientific in origin and much of the radiography education that I have taken was based on physics and biology. I have always felt that radiography education is biased towards empirical science to the detriment of the human side of radiography. Radiographers deal with people in their professional practice but this area of their work has often been neglected particularly

in radiography education and literature. Since becoming a radiography educator I have tried to remedy this situation by introducing a more person based syllabus. I now teach mainly patient care subjects. In developing new radiography courses I have always tried to balance the technology side of radiography with a patient care side. To sum it up I feel that radiography is about people not machines. It is my belief that if radiography is to grow as a profession it is this people side that must be developed. I feel that those who advocate that radiography can only grow by becoming more technologically biased are short sighted. Technology is growing at such a fast rate that radiographers can not hope to be experts in every aspect of it. In my opinion radiographers should be experts in the application of technology and form a caring interface between technology and people.

Since taking up radiography in 1980 I have always felt unease about the relationship between radiographers and medical practitioners. I feel that radiographers have more to offer than they are allowed to as a result of the influence of medical doctors. I believe that radiographers could take on some of the roles that have traditionally been undertaken by radiologists, and if they were freer to communicate with their patients, could offer a better standard of care. I have been involved professionally with the development and extension of the radiographic role. I have undertaken research into the introduction of radiographic abnormality scheme (red dot scheme) and have helped to develop courses in radiographic image interpretation.

One of the reasons why I am so attracted to sonography is that I feel these professionals are undertaking an extended role that demonstrates the capability of all radiographers. Most sonographers communicate much more freely with their patients.

They also make diagnostic judgements and write reports about the images that they produce. Sonographers provide a good role model for radiography.

I undertook higher professional qualifications that involved undertaking research. For my Higher Diploma of the College of Radiographers I undertook a project which looked at extended roles for radiographers. This used an empirical scientific methodology. This involved judging radiographers' test results against those of a radiologist. During this research I became disillusioned with the purely positivist approach. This was because the results seemed quite limited and the part of the research that I enjoyed the most, and that seemed to be most productive was where I asked for peoples' opinions. I entered radiography education as a student teacher and undertook the Teachers Diploma of the College of Radiographers. For this qualification I undertook research into students' learning styles. This study relied on qualitative techniques.

I became interested in the politics of the health service and studied for a Master of Arts degree in Politics and Government. This exposed me to qualitative research methods and I undertook research that used interview techniques. This had an impact on me as I became exposed to the benefits of interviews and the collection qualitative data.

Soon after being awarded my MA I began to work for the Open University in the United Kingdom teaching Professional Judgement and Decision Making. This experience had a profound effect on me. The course used analytical and quantitative techniques but in a manner that was new to me. Analysis and measurements were

used to explain and describe. It was after gaining this experience that I decided that for a longer research study (my PhD) I wanted to combine analytical methods within the paradigm of qualitative research.

3.6 Sample

This section will discuss how hospitals, radiographers, sonographers and patients were selected for this study. A decision was made at the beginning of the study to locate the research in the North West of England. This was mainly for convenience. It proved cost effective to situate the study in the area where the author was based. In the later stages of the research, it was also convenient to choose sonographers and a patient from close to where the author was based. This allowed them to travel to the University Department to be interviewed with the least inconvenience (interviews had to take place in the University Department due to the use of specialist computer equipment). Although the location of the research in the North West of England may have limited the study in some respects, these should be minimal because of the requirement that radiographers work under national guidelines and codes of practice.

The study was based in four hospitals, the Royal Preston Hospital in Preston; the Royal Lancaster Infirmary in Lancaster; the Furness General Hospital in Barrow in Furness and the Blackpool Victoria Hospital in Blackpool. The criteria used to select hospitals from which to collect data was that they were in the North West of England, were general hospitals, had accident and emergency departments, had sonography departments and had at least 20 radiographers working in them. Large teaching hospitals were excluded on the grounds that they train radiologists and this often means that clinical decisions and judgements made by radiographers and

sonographers are frequently referred to radiologists and their trainees as part of the clinical teaching process.

Another important reason for choosing these four hospitals was that the author had links with them through his University Department (The Department of Radiography and Imaging Sciences at the University College of St Martin, Lancaster). Student radiographers regularly visited these hospitals to gain work experience. Because of this, the author was well known to the departmental managers, radiographers and sonographers. This gave the author free access to the clinical departments and enabled advantage to be taken of the professional relationship which existed between the researcher and the radiographers and sonographers.

It was also decided to limit the study to general and accident and emergency (A&E) radiography. Contrast studies such as Barium examinations were excluded as were special procedures such as computerised tomography and magnetic resonance imaging. The study was confined to general and A&E radiography primarily because this is the field of radiography in the UK where radiographers are developing an extended role. In these areas, radiographers also work increasingly autonomously without recourse to medical doctors. In the other more specialist areas by contrast the radiographers work in medically led teams. At the time of the research, all four hospitals selected had a radiographer abnormality detection scheme (red dot scheme) in place but none had developed radiographic reporting.

3.7 Ethical considerations

This study was devised and conducted in accordance with the Open Universities guidelines on ethics (Open University 1998). The steps taken to ensure that the research met the Open University's ethical standards are outlined in this section.

3.7.1 The survey

Two hospitals were chosen for the survey. Before the questionnaire was sent out, the departmental manager was contacted by letter and telephone and permission sought to undertake the survey. The managers were informed about the scope of the survey and were provided with a copy of the questionnaire. They were invited to send the proposal to their own hospital ethics committee if they felt that was necessary. The letter offered to provide extra information if required. In both cases permission was granted without referral to hospital ethics committee. Both managers decided that a voluntary questionnaire that did not involve patients did not need referral to hospitals ethics committee.

The questionnaire was sent out with a covering letter to all radiographers and sonographers in these hospitals regardless of grades. Those who received the questionnaire were free to respond to the questionnaire. In the covering letter the sonographers and radiographers were informed that the responses to the questionnaire was confidential. The completed questionnaires were returned in stamped addressed envelopes that were provided. The results of the questionnaire are shown in Appendix 12.

3.7.2 Observational study

The managers of radiography and sonography departments were contacted by letter and by telephone. Details of the research were given, including the purpose and the nature of the observations. The managers were invited to consider the ethical implications of the research and to submit the proposal to the hospital ethics committee if they judged this necessary. All managers felt that this was not required in their hospitals because staff rather than patients were to be observed. Since the researcher was a qualified radiographer they felt that his presence during radiographic or sonographic examinations would not pose an ethical issue. They did feel however that all staff participating would have to give their prior permission. Staff from the University routinely visited these four hospitals to observe student sonographers and radiographers. One of the managers did discuss the research with the hospital's research co-ordinator but they also felt that the observations would not need to be considered by the hospitals ethics committee although a summary of the research to be undertaken would have to be submitted to the hospital's research office. This was done. All managers were asked by the researcher to discuss the research with their staff to ensure that they were happy to take part in the research. All managers reported that the proposed observations had been discussed with departmental staff. The managers had informed their staff that they were free to take part in the study and under no pressure to do so. All radiographers and sonographers at the four hospitals agreed to participate in the study.

Two of the managers were also contacted by letter to seek their permission to distribute a survey questionnaire to their staff. The letter included a copy of the questionnaire. The two managers gave permission.

3.7.3. Interviews with key informants from the ultrasound profession

The key informants used for this study were the Chair of the Radiographers Board of the Council for the Professions Supplementary to Medicine, The President of the College of Radiographers and a Sonography Educator. All informants were contacted by letter, the letter explained the nature and the purpose of the research. The letter also contained a request asking them if they would mind being interviewed. The letter stated that they would not be mentioned by name in the research but it was made clear to them that because of their position it was likely a reader of the study could deduce their identity. All informants contacted agreed to take part in the research.

At the commencement of the interview the nature and purpose of the research was once again explained to the participants. The issue concerning the researchers inability to keep their identity completely confidential was also discussed. All participants said that they fully understood this and that they were willing to take part in the research under these conditions.

3.7.3 Interviews with patients and sonographers

The sonographers and the patient who were interviewed were contacted by letter. The nature and purpose of the research was explained to them in the letter and they were asked if they would mind being interviewed. The letter explained that their identity would be kept confidential. The letter also stated that they were free to take part in

the study or not. All contacted the researcher stating that they were willing to take part.

At the start of the interviews the nature and purpose of the research was explained. The participants were told that they would not be mentioned by name in the thesis or any publications. They were told that they were free to withdraw from the study at any point. All agreed to take part in the research.

3.8 Summary

Details of the study are contained in the chapters that follow. This chapter has described and discussed how the interpretative paradigm was selected to guide this study. It also discussed how a traditional phenomenological approach to data collection was adapted by using decision analysis. It is argued that the use of decision analysis will enhance the phenomenological method.

Through a reflexivity statement an attempt was made to expose the background, biases and opinions of the researcher. It is hoped that this statement will help the reader of this study to evaluate it. Details of the hospitals that were used in this study are given and how they were selected. Ethical issues have also been considered in this chapter and the study complies with the guidelines set by the Open University.

Chapter 4

Survey of decision making and judgement within radiography and sonography

4.1 Introduction

One of the underlying research questions of this study is “what is the scope and nature of decision making within radiography and sonography?” Preliminary data was collected to answer this question by undertaking a survey using a questionnaire approach. The questionnaire was kept short in the hope that response rates would be high. The main objective of the survey was to gain some insight into the perceptions that radiographers and sonographers had of their decision making and judgement. The questionnaire used for the survey therefore sought to establish how radiographers and sonographers: saw decision making; perceived the types of decisions that they made; thought about the evaluations of the outcomes of their decisions; regarded the outcomes of their decisions; and felt about training and information about decision making.

4.2 Formulation of the questionnaire

Issues regarding the use of surveys were discussed in chapter 3 section 3.3.1. A questionnaire was drawn up using closed questions. Because the aim of this survey was to gain preliminary data it was decided to make the questions succinct. The questionnaire was piloted by distributing it to seven work colleagues. Six of these colleagues were radiographers and one was a sonographer. All were Senior Lecturers

in the Department of Radiography and Imaging Sciences at the University College of St Martin in Lancaster in the North West of England. There were two females and five males. The sonographer was a male. All taking part in the piloting of the questionnaire were aged between 40 and 55 years. This test took place in April 1993 and all questionnaires with comments were returned within one week. All were asked to answer the questionnaire and to comment on the format and wording of the questions. As a result of this exercise the questionnaire was modified. The final version of the questionnaire used for the survey is shown in Appendix 1.

4.3 Distribution of the final questionnaires

Lancaster Royal Infirmary and Furness General Hospital were chosen for the survey because they were of similar size to the other two hospitals that had been chosen to be included in the study (see chapter 3 section 3.6).

The questionnaire was sent out with a covering letter to all radiographers and sonographers in these hospitals regardless of grades. Those who received the questionnaire were free to respond to the questionnaire. In the covering letter the sonographers and radiographers were informed that the responses to the questionnaire were confidential. Each questionnaire was marked with a code to identify the hospital and department that it came from. The completed questionnaires were returned in a stamped addressed envelope that was provided. The results of the questionnaire are shown in Appendix 12.

4.4 Survey results

The response rate to the questionnaire was a disappointing rate of approximately 50%. There was no follow up of the questionnaire and this may have led to the relatively low response rate. The responses to the questionnaire did however provide the background information that was required. In summary all radiographers and sonographers felt that they did make decisions in their professional practice. Both radiography and sonography groups identified a number of different decisions, but exhibited some confusion regarding the difference between decisions and judgements. The sonographers in the response to question two, which asked them to identify decisions that they made included statements such as “judgements about missed abortion”, “decide if a foetal heart was present”, “deciding if scan was normal”, “judgements about foetal viability”, and “decisions about foetal normality”. Five of the eight responses given by the sonographers could be considered to be judgements rather than decisions. This level of confusion was also seen in the radiographers’ responses to question 2 which asked for examples of decisions made regularly in professional practice. Their responses included: “checking the films for technical quality” and “when to put a red dot on”. The radiographers also included vague statements such as “working with other departments”, “dealing with patients”, “organisation of workload” and “as a result of problem solving”. Although all sonographers and radiographers felt that they made decisions in their professional practice they do seem to have difficulties in identifying these decisions. Although from this evidence this would seem to be a particular issue for both the radiographers and sonographers and perhaps for all health care professionals.

Some of the decisions identified in both groups were given by more than one respondent. This could indicate that these were decisions that occur regularly or that radiographers and sonographers consider these to be important decisions. The decisions that were identified more frequently for example from the radiographers were; “which views to undertake”, “checking films for quality” and “organisation of workload” and from the sonographers “what information to give to patients” provided a good indication of issues to be followed up later in the research.

All those questioned stated that they evaluated the outcomes of their decisions to some extent. The response to question four, which asks the practitioners if they are happy about the outcomes to their decisions, indicates that both groups are positive in regard to the outcomes of the decisions made. The majority of the respondents were “happy” with the outcomes of their decision making most of the time. There is no indication of the nature of the evaluation used by the practitioners.

All respondents who completed the survey were qualified health care professionals. It is therefore noteworthy that the majority of them have no training in, or been given any information on decision making. One radiographer crossed out the question asking them if they had had any training in decision making and wrote “EXPERIENCE”. This same radiographer went on to give a negative response to the question asking them if they thought they would benefit from training/information in decision making and judgement. All sonographers felt that they would benefit from some training in decision making, two radiographers felt that this training would not be useful.

Although the survey did not provide detailed data about decision making and judgement in radiography and sonography it did give a useful indication of issues to address in the next stage of the study. It also had an important pragmatic benefit in that it began to form research links with two of the hospitals to be used in the larger study.

Chapter 5

Observations of radiography and sonographers

5.0 Introduction

The first research question (what is the scope and nature of decision making and judgement in radiography?) had not been fully answered by the survey of radiographers and sonographers. The results had, however, indicated that radiographers and sonographers did make clinical decisions and judgements although they were not clear about the difference between the two. The survey also indicated that some types of decisions were perceived (by radiographers and sonographers) to occur more often or to be of more importance than others.

In the next stage of the study, decision making in radiography and sonography was studied using observational methods. The prime purpose of the observations was to further address the scope and nature of the decision making and judgement. The four hospitals identified in chapter 3 section 3.6 were used for the observations. Two sets of observations took place, one involving general radiographers and the other sonographers.

5.1 Radiography observations

The researcher made a two day preliminary visit to Furness General Hospital in June 1994. This visit was to establish how the observations could be organised. During this visit the researcher shadowed four different radiographers who worked in the

Accident & Emergency (A&E) and general radiography work area (these are combined at Furness General Hospital) for half a day each. The researcher accompanied the radiographers into the examination rooms and discussed issues (regarding the radiographers judgements and decisions observed by the researcher) with them while they were waiting for films to be processed. Notes were made which recorded clinical decisions and judgements that were observed. From the preliminary visit to Furness General Hospital the following decisions were made:

- to treat general radiography and A&E radiography as a single entity;
- to treat the radiographers as a single entity regardless of grade;
- to develop a tool to record the observations;
- to spend five working days in each of the four hospitals.

A&E and general radiography were treated as a single entity because the work in these areas was similar. Radiographers were undertaking the same type of examinations on each group of patients. The only difference between the two types of radiography was the referral mechanism of the patient and in some A&E patients the acute nature of the complaint. The work area for both groups of patients was combined at Furness General Hospital so patients from both groups were examined in the same rooms.

A mixture of grades of radiographers made up of Basic Grade Radiographers, Senior II Radiographers, Senior I Radiographers and Superintendent IV Radiographers worked in these areas. From the preliminary observations made at Furness General Hospital it seemed that all of these radiographers were undertaking similar functions in relation to their radiographic work. Initial observations suggested that all grades

made a similar range of judgements and decisions. For this reason it was decided to collect data on “radiographers” as a group, rather than divide them into grades. However, it was decided only radiographers who had been qualified for at least one year and had been working at the hospital concerned for one year were observed. This was to ensure that all radiographers being observed would have experience of both radiography and that hospital in particular and were not in a “learning” mode in either respect, as this might have an impact on their decision making.

The two-day preliminary visit to Furness General Hospital was also used to refine data collection methods. Simply taking notes in a notebook had been difficult during the preliminary visit primarily because of time constraints. An observational recording tool was developed to ease the burden of recording data during the observations. This is shown in Appendix 9.

During the visit to Furness Hospital approximately 20 examinations of patients by radiographers were observed on each of the two days. During these examinations between five and 10 judgements or decisions were observed. The researcher decided to aim to observe 250 examinations. He felt that this would give a sufficiently large sample. The main purpose of the preliminary visit was to plan the main visits and organise the data collection, for these reasons the data collected during the preliminary visits is not presented in this study.

The observational visits were organised between June 1994 and January 1995. One visit was made to each of the four hospitals. Each hospital was visited for five consecutive days except Blackpool Victoria Hospital, which was visited for eight

days (the reason for this is explained below). At Blackpool Victoria Hospital four days were spent in the general radiography work area and four in the A&E area. At the Royal Preston Hospital, two and a half days was spent in the general work area and two and a half in A&E. This was because at both Blackpool and Preston the A&E and general areas were separate. At Furness General Hospital and Lancaster Royal Infirmary these areas were combined, so five days was spent in each. During the visits the researcher shadowed a different radiographer on each day so that in each hospital five radiographers (except at Preston where six radiographers were observed because of the arrangement of A&E and general radiography - two radiographers were shadowed for half a day each) were observed and overall 24 radiographers were observed. The researcher went with them into the examination rooms and observed the radiographic examinations. During the examination, the researcher did not take part in the examination in any way. The researcher also accompanied the radiographers to the film processing areas. The case was discussed with the radiographer with particular reference to judgements and decisions that were made. Radiographers were observed undertaking between 15 and 32 examinations each day. After the first day of observations it was found that the researcher needed time to write up observations on the observational test tool after each examination. For this reason, only every other examination was observed with the observations being written up during alternative examinations. The total number of examination observations is shown in Table 3.

| Hospital | Number of examination observations |
|-----------------------------|---|
| Lancaster Royal Infirmary | 60 |
| Furness General Hospital | 51 |
| Royal Preston Hospital | 62 |
| Blackpool Victoria Hospital | 106 |
| Total | 279 |

Table 3 Number of radiographic observations by hospital

The first visit was made to Blackpool Victoria Hospital. After three days of observations it became clear that the observational tool was inadequate for the purpose of the observations. Many of the judgements and decisions were made during each examination. It became difficult to note and record all of these. Some of the judgements and decisions were common to all examinations. The observational tool was refined so that these common judgements and decisions could be recorded more quickly. The main change to the tool was that more of the very common decisions and judgements were included so they could be ticked off rather than noted. Once the observational recording tool had been refined (Appendix 10), Blackpool Victoria Hospital was re-visited.

While at Blackpool it was also decided to keep a reflective diary of the visits. In this diary the researcher attempted to record general observations and feelings about the observations that were made regarding decision making and judgement. Information such as the general departmental environment and perceived culture were recorded. This information was not captured on the observational tool. Each evening after the day in the hospital short notes and key words were entered onto the computer. These notes were then written up and developed on the weekends after the observations. An

entry was made for each hospital. As mentioned the researcher also took the opportunity to discuss cases with radiographers while films were being processed. At these times radiographers were asked questions about the judgements and decisions that had been observed. The researcher's observations of radiographic practice were also shared with radiographers during rest periods (tea breaks and lunch breaks). Feedback from this kind of interaction was recorded in the reflective diary. The purpose of these questions and discussions with the radiographers was to validate the observations.

5.2 The scope of radiographic decision making

The data resulting from the observations was analysed with reference to the research question that was being asked at this stage of the research i.e. "What is the scope and nature of decision making and judgement within radiography". In the context of this research "scope" of decision making relates to the type of decision that is being made and the "nature" pertains to the inputs, processes and outcomes of decision making and judgement. Issues that need to be considered to study the nature of decision making and judgement are the mode, time taken, limitations, guidelines, policies, influences and impact of the decision making and judgement.

It was decided to group the decisions and hence to form a classification of radiographic decision making. The researcher devised the groupings after thorough examination of the observational data. Three decision groups were identified: the managerial group of decisions; the technical group of decisions and the

communication group of decisions. The data was then re-examined to see if all decisions that were observed could be put into these three groupings.

Management decisions included decisions associated with the organisation of the work place activity. These decisions involved either organisation of the physical workplace or organisation of people within it including student radiographers and those accompanying patients. Management of patients was considered to be part of the technical work of the radiographer, so was put into the technical group. In this study an observed decision had to meet at least one of the following criteria to be included in the management group:

- involved the management of people (staff, students);
- involved the management of workplace activity;
- involved the education of students;
- involved the management of people accompanying patients.

The technical group of decisions was those made by the radiographers while practising radiography. For the purposes of this classification radiography is considered to be the production of diagnostic medical images together with the care of the patient while these images are being produced and initially examined. To be included in the technical group of decisions a decision had to meet one or more of the following criteria:

- involved physical care of the patient;
- involved emotional care of the patient;
- involved decisions regarding the radiograph that was produced;
- involved radiographic positioning;
- Involved manipulation of the radiographic equipment.

The final group of decisions concerned communication. Radiographers were observed giving varying amounts of information to their patients. Patients were also observed asking for information. From the way that radiographers communicated with their patients and the differing amounts of information that was given to different patients it became clear that radiographers were making decisions regarding how much information to give to their patients. They were also making decisions regarding the manner in which to give the information. Radiographers were also communicating with medical doctors, radiologists and the referring clinician. To be included in this communication group the observed event had to meet one of the following criteria:

- Involved giving information to a patient;
- Involved communicating with another health care professional regarding the case;

After re-examining the data it became apparent that the management grouping really had two quite distinct orientations, management of people and education. It was accordingly decided to split this category into two, management decisions and educational decisions. The data was therefore classified into the following groups:

- managerial decisions;
- educational decisions;
- technical decisions;
- communication decisions;

It was found that all of the observed decisions could be satisfactorily classified using these groups. These groups are of course imposed by the researcher on the complex reality of practice. The classification does however appear to fit the observations made and helps us begin to develop a better understanding of the “scope” of radiographic decision making. The following sections illustrate the groups by giving examples that were observed.

5.2.1 Management decisions

All radiographers made management decisions. Management of patients was common to all examinations. Radiographers decided which room to take the patients into. For example, a patient who came to the A&E department at Furness General Hospital with a suspected fractured hip was made to wait for ten minutes until the largest x-ray examination room became available, even though a smaller room was available. When questioned about this the radiographer stated that the larger room

was better suited to this type of examination and that they had decided to let the patient wait until it became available. This indicated that the radiographer was not simply examining the patient as quickly as possible, but was making judgements regarding the patients condition and the acceptability of the results that could be obtained from different equipment.

Radiographers were observed managing people. Often patients arrived in the x-ray department accompanied by friends or relatives. One patient at Blackpool who was referred for a skull x-ray examination from the A&E department was accompanied by her husband. When the radiographer went to bring the trolley into the examination room the husband tried to follow into the room. The radiographer told the husband that they could not come into the room because of the radiation being used. When asked about this after the examination the radiographer said that she did not like relatives to come into the room "because they got in the way". When asked about what she had told the patient she said that radiation was not a major concern but it was an explanation that people listened to. This type of management decision was also seen when children were being examined. Some radiographers allowed parents into the room and others did not. This issue was discussed with radiographers at all centres and it was found that there were differing opinions about parents coming into x-ray rooms with their children. One radiographer said that the parents were worse than the children and tended to make the examination more difficult. Another said that children tend to "play up" more when their parents are present. On hearing this another radiographer in the staff room while this was being discussed stated that she always allowed parents into the examination room and made sure that they assisted in the examination. In each of the four hospitals there seemed to be a

dichotomy of opinion about this topic. These differing judgements about the effect of parents led to different decisions being made by different radiographers. This indicates that the radiographers are not simply following protocol but are making management judgements and decisions.

Other management decisions were also observed. A prisoner was referred to the department for a chest radiograph. The prisoner attended the x-ray department hand cuffed to a prison warden. The radiographer made the decision in consultation with the prison officer that the prisoner's handcuffs should be removed before the examination. This was done and the prisoner was examined without incident.

Radiographers were also observed organising their work activity. In all x-ray departments observed, radiographers were seen deciding on the order in which examinations were performed. This was particularly evident in relation to the work that was referred from the A&E department. At Furness Hospital request forms for examinations were processed by the departmental office then put into a box in the "viewing" area. Radiographers then took the request forms from the box and performed the examination. Radiographers were observed going through the box of request forms rather than simply taking the one that was at the top of the pile (the one at the top of the pile would be the one that had been waiting the longest). When asked why they did these radiographers stated that they were deciding which request was the most urgent and which ones could wait. Some of the requests were for patients who had urgent life threatening conditions. The judgements and decisions being made by the radiographers in this area could clearly have important consequences for the patients' state of health.

5.2.2 Educational decisions

Education decisions made by the radiographers were also common in all hospitals observed. There were student-radiographers present in all of the x-ray departments observed. These ranged from first year students to final year students. At Lancaster Hospital there was also one student who was undertaking extra clinical education because she had failed her competence assessment in the final year of her course. All radiographers observed had some interaction with student radiographers during the observations. Students often brought radiographs to the radiographers to decide if they were of a quality to be passed on for reporting or if they needed repeating.

Radiographers were also observed deciding on the level of supervision to give to students. Some students were given direct supervision with the radiographer accompanying the student into the examination room and directly checking radiographic positioning and exposures. Radiographers decided to allow other students the freedom to carry out the radiographic examinations unassisted. The level of supervision did not seem to be based on the students' experience. A second year student at Blackpool Hospital was observed undertaking skull radiography unassisted while a third year student at the same hospital was supervised very closely.

5.2.3 Technical decisions

Technical decisions were observed during all radiographic observations. Radiographers decided which projections to take, what radiographic exposures to set and how to position the patient. At Blackpool Hospital a request form asking for a

skull examination for a hormonal disorder came to the department. The radiographer decided that a full skull examination was not required and instead did a simple one view examination. In all observations made during this stage of the study radiographers also judged if the images that they produced were of an acceptable quality or not. They made a decision to repeat the examination or not.

Radiographers were also observed making the decision to give or not to give the patient lead protection. The amount of lead protection given varied from radiographer to radiographer. One radiographer at Preston was observed giving lead protection to some patients and not to others. When asked how he made that decision he stated that his decision was based on the patient's age and if he thought that the protection would get in the way of the examination. He also said that when he was in a rush he tended not to use lead protection.

5.2.4 Communication decisions

Radiographers were observed communicating extensively with patients and other health care professionals. Radiographers constantly decided what level of information to give the patient after the examination. In one case, at Blackpool Hospital, a patient's wrist was examined. When the patient was given the films to take back to the A&E he asked the radiographer if it was broken. The radiographer said "I'm not allowed to tell you but I think I will see you soon when they have put the plaster on it". Other radiographers were observed giving patients a diagnosis after they had seen the radiographs. One radiographer at Lancaster was observed giving a patient a diagnosis and a prognosis. They told a patient with a fractured wrist that it

was broken and that after it had been in plaster for six weeks it would be as good as new.

During the observations only patients who were referred from A&E were given a diagnosis. In-patients, outpatients and GP patients were never given a diagnosis from the radiographer. An observation made of a GP patient being examined at Preston is typical of the interchange that radiographers have with this type of patient. The patient had had his lumbar spine x-rayed to look for evidence of osteoarthritis. When the radiographer told the patient that the radiograph was technically fine and that they could go, the patient asked what the x-ray had shown. The radiographer told the patient that a consultant would examine the radiograph and that the report would be with the patients GP in a week to ten days.

Radiographers were also observed communicating with doctors. In all the hospitals visited a radiography abnormality detection system (red-dot system) was in place. The radiographers observed could decide or not to indicate that an abnormality was present by placing a red dot on the image.

Radiographers were also observed communicating with the radiologist who would report the case. They did this by adding comment to the request card that would be read by the radiologist. In the 35 observations where this occurred the comment was regarding the patients' condition. In one case, at Blackpool, a patient came in drunk. This had not been mentioned on the request by the referring doctor in A&E. The radiographer indicated in a written comment on the request form that the patient was drunk. When asked why he had decided to do this he said that his films had not been

perfect because the patient had moved. He wanted to include the comment so that the radiologist would understand why the images were not optimal. Another example of this type of observation came from Furness Hospital. Here a patient was referred from A&E for a knee examination. The request form stated that the patient had fallen and the doctor was questioning if the patient had a fractured knee. The radiographer questioned the patient and found out that he had fallen over two weeks ago. The radiographer wrote on the request card "Fell over two weeks ago. Walked round from A&E!!!" When asked why she had decided to write this comment on the request form she said that she thought the request was a waste of time and she wanted the radiologist to know the "kind of rubbish they are sending round from A&E".

The observations confirmed the data that had had been collected in the survey. Radiographers did make many and diverse decisions. The radiographic decisions could be grouped using the classification that was devised and this proved essential in managing the large amount of data that was generated during this part of the research.

5.3 The scope of radiographic judgement

Radiographers were observed making judgements as part of their radiographic practice. These judgements were closely linked with the decisions that were observed. The same "classification" method used for radiographic decisions was also used to establish the "scope" of the radiographic judgement. As with the decisions observed judgement data was evaluated and a classification of radiographic judgement devised. These were then used to produce a classification of radiographic

judgement. The preliminary groups selected by the researcher were judgements relating to:

- examination requests;
- patient condition;
- pathology;
- radiographic images;

The data was then re-examined to establish if the observed judgements could be classified using this system. It was found that there was a group of judgements that did not fit easily into the identified classifications. These were judgements regarding the patient's physique and were closely linked to the decisions that radiographers made regarding the radiographic exposure. While these judgements were most closely associated with judgement of the patient's condition, they did not fit into this classification correctly. For this reason it was decided to divide the patient condition classification into two classes - radiographic exposure group of judgements and patient condition judgements. The five classifications are as follows:

- 1) Examination requests;
- 2) Patient condition;
- 3) Pathology;
- 4) Radiographic images;
- 5) Radiographic exposure.

Despite this refinement not all judgements could be fitted into these groups. At this stage the classification was simplified. The new classification was based simply on

what radiographers make judgements about: examination requests, patients condition and radiographic images. All judgements could be grouped using this classification.

5.3.1 Examination request judgements

Radiographers were observed making judgements about the examination request forms. For instance a request form asked for an orthopantogram examination of the mandible. The radiographer judged that this was an inadequate examination to assess the whole of the mandible. After seeing the OPG radiograph she then went ahead and did further views of the mandible.

In all four hospitals radiographers were observed judging that examination requests from the A&E department were unnecessary. For example a radiographer at Preston made a judgement that a request for an examination of a lumbar spine was inappropriate. When asked how she had come to this judgement she said that the patient had walked into the department, there had been no history of trauma and that the doctor requesting the examination “asked for every thing to be x-rayed”. Even so the examination was performed. When the radiographer was questioned as to why she had decided to undertake the examination when she did not feel it was justified she stated that *“it is too much trouble to make a fuss, the radiologists here never back us up when we refuse to x-ray a patient”* (from field notes).

A similar example of this kind of judgement was seen at Lancaster when a patient attended the x-ray department from the A&E department with a request for a foot and ankle x-ray. The patient had sustained the injury two weeks before presenting at the A&E department. The patient walked from the A&E department to the x-ray

department. The radiographer indicated to the researcher that this examination was “a waste of time” and that the referring doctor should decide on either a foot or an ankle examination - not ask for both. The radiographer then proceeded to undertake an examination of the foot and ankle.

On another occasion a radiographer judged a request for an elbow examination to be inadequate. The request form asked for an elbow AP (anterior/posterior) Lat (lateral) to exclude a fractured head of radius. The radiographer told the researcher that these were not the correct views to demonstrate this type of fracture. The radiographer went on to take an AP, lateral and two oblique views of the elbow.

These examples demonstrate that radiographers do make judgements about the requests that they receive for x-ray examinations. They do not simply take the requests at face value, but make judgements and subsequent decisions regarding the examinations that they perform.

5.3.2 Patient judgements

The radiographers judged many characteristics of the patients. These included the patients' physical, emotional, psychological and social condition. In some cases patients presenting to the x-ray department on trolleys for chest x-rays were made to sit with their legs over the side of the trolley and an PA (posterior/anterior - the standard chest projection) projection was taken. In other cases the patients were left laying on the trolley and an AP projection taken. When questioned about this when processing the film radiographers reported that they had either judged that the patient was well enough to sit or too ill to do so. In some cases the referring doctor had

requested a PA view but an AP was taken because of the radiographers judgement. In no examination observed was an AP requested - but a PA produced.

Radiographers made judgements regarding their patient's physical condition. This judgement had an important impact on how the examination was performed. A radiographer at Blackpool had a request to do an Anterior Posterior and a Lateral view of a patient's elbow. The radiographer judged that the patient was in too much pain for these views to be taken so instead she performed a lateral view and a axial view of the elbow. Radiographers in hospitals were seen making judgements about the patients' condition in relation to their ability to be moved onto the x-ray table. This judgement impacted on how the patient was to be moved if at all. A radiographer at Lancaster judged that a patient from one of the wards was not fit to be moved over onto the x-ray table. The patient had cancer in their bones and a thoracic spine examination had been requested. The optimal way to carry out this examination is on the table, but this radiographer x-rayed the patient on the trolley.

Radiographers were also observed making adjustments to radiographic exposure based on a judgement of the patients' physical characteristics. All of the x-ray examination rooms which were used to undertake these observations had radiographic exposure charts. These charts had lists of x-ray examinations and a suggested set of exposure factors for an average patient. Radiographers were observed judging the size of the patient against this ideal average patient. The radiographic exposure was set in light of this judgement of patient size. Radiographers were seen interacting with patients in different ways. Some interactions were very informal, while others were formal. Examples of this were

seen in all hospitals and in all radiographers. A particular example of this occurred at Preston Hospital where a radiographer was observed calling some patients by their first name and others by their title and surname. When the radiographer was asked why she took these different approaches she stated that it was based on her judgement of how the patient would like to be treated. When the radiographer was asked what she based this judgement on she said that it was mainly the age of the patient and how the patient had responded to them in the waiting room.

5.3.3 Radiographic image judgements

Radiographers judged the radiographic image in two ways. All examinations were assessed for technical quality. Radiographers judged if the images that they produced were of an acceptable quality for diagnostic purposes. Radiographers also judged the radiographs for the likelihood that they demonstrated a pathological abnormality. These judgements led to decisions regarding adding red-dots and repeating examination.

In all examinations radiographers made judgements regarding the technical quality of the radiographs that they produced. The radiographers decided if the images were of a sufficient quality to make them diagnostic. In all of the hospitals, radiographers were also seen making judgements about the technical quality of student-radiographers radiographs. This is a judgement that student radiographers are not allowed to make. They must refer this decision to a qualified radiographer.

At Furness Hospital, a radiographer was asked to examine a patient's lumbar spine for a suspected fracture. This radiographer did the anterior-posterior projection first.

This was judged by the radiographer to show no fracture. This judgement led to a decision by the radiographer to turn the patient onto his side for a lateral projection of the spine. This example shows that radiographers make diagnostic decisions that can be considered radiological. If the radiographer made a wrong judgement and based a decision to move the patient on this judgement there could be important legal implications for the radiographer and health ones for the patient.

5.4 The nature of radiographic judgement and decision making

From the observational evidence, it is clear that radiographic judgements and decisions are closely linked and that the nature of these two aspects of professional practice can be considered together. In relation to this research the nature of judgement and decision making is defined as concerning the autonomy of the judge and decision maker, the mode of cognition that they use, the limitations to their power to make decisions and judgements and the guidelines, policies and protocols that influence these decisions and judgements. The evidence used in this section comes from both the observations made and entries in the reflective diary.

Before going on it is worth reflecting on similarities and differences between the radiographic practice seen in each of the hospitals. The similarity between the range of decision and judgement processes observed in all four hospitals was striking. The range and examples of decision making identified across all four departments were similar. The decision classification could be used in all four departments.

There was, however, a difference in the approach to decision making between different hospitals. At Furness Hospital the radiographers seemed to delegate more of the decisions and judgements to radiologists working in that department. For example if radiographers were not sure about the technical quality of a radiograph they were much more likely to seek the advice of radiologists rather than make judgements and decisions themselves than in other hospitals.

In all observed examinations there was a strong link between the judgements and decisions made. Radiographers were observed making judgements which fed into decisions. A simple example of this was observed when radiographers made technical judgements about their radiographs, these fed into decisions about repeating or not repeating the examination.

All decisions seemed to be based on a judgement but not all judgements led to a corresponding decision. Examples have been given above on the scope of radiographic judgement and decision making which show that some examination requests were judged to be inappropriate by the radiographers but the examination was still undertaken. It may be in cases such as this that multiple judgements are feeding into the decision and that the radiographer is giving the results of some of these judgements greater weight than others. So the radiographer that judged that the knee examination was inappropriate also judged that if she refused to undertake the examination the radiologists would not back her up. The second of these two judgements had a greater impact on the decision to undertake or not undertake the examination and the examination was performed.

Some judgements mapped into more than one decision. For example judgements regarding physical condition led to decisions regarding the type of examination to perform, to repeat or not repeat the examination and to add a red dot indicator or not. Decisions were also seen that were influenced by more than one judgement. The decision to repeat or not repeat an examination was based on judgements not only of the technical quality of the radiograph but also on the physical condition of the patient. A radiographer did a chest radiograph of a man who was on his way from the A&E department to the Intensive Care Unit. The radiograph was of poor technical quality but the radiographer decided not to repeat the examination. When the radiographer was asked about this he said that he would normally repeat such an examination but felt that the patient was too ill to go through the examination again so he had decided not to repeat.

Observation of practice shows quite clearly that the experienced radiographers observed made judgements and decisions in very short periods of time (in many cases in a matter of seconds or even less). At no time during the observation period did radiographers use any form of formal analysis. This suggests that radiographers make decisions in an intuitive manner based on intuitive thought as defined by Benner (1984, 1999). Radiographers were observed asking student radiographers to evaluate their radiographs in a systematic manner by using checklists. Radiographers gave students lists of criteria by which they should check their films. These included image density, contrast, position, rotation presence of anatomical marker, patient identification. Students were told to go through these criteria in a systematic manner. However when radiographers checked their own films there was no evidence that they did this themselves. This observation would support the theory of practice put

forward by Dreyfus and Dreyfus (1985). In this theory they state that as practitioners become experts they move from using analysis to using intuition.

From the observations there is a good deal of evidence to suggest that peer aided decision making is used. Radiographs, which are of borderline quality, are often discussed with colleagues. This is a formalised aspect of radiography education - all student radiographers must have their radiographs checked by a qualified radiographer.

The judgements and decision making behaviour of radiographers is influenced to a degree by policies, guidelines and codes of practice (for the purpose of this discussion these will be termed rules) that were in place at the time of the observations. Some of the rules were common to all departments such as the Code of Professional Practice issued by the Council for the Professions Supplementary to Medicine. Other "rules" were local such as the imaging position protocols (these list what radiographic projections should be taken for each area of the body). On a number of occasions radiographers referred to the national policies with comments such as "I shouldn't have told him that" (referring to telling the patient that they had fractured their toe) when asked why not the radiographer stated that they could get "struck off" for telling a patient a diagnosis. This type of comment was common in all departments that were observed and seemed to impact most prominently in the area of patient communication. Radiographers were observed using phrases like "I cannot tell you, I am only the radiographer" when patients asked them what was shown on the radiograph.

5.5 Sonographic observations

Observations of sonographers working in four different ultrasound departments were made between March 1995 and July 1995. The four hospitals (see chapter 3 section 3.3) used for the radiography observations were also used for the sonography observations. The method used to observe radiography was also used for the sonography. The sonography department at Preston Hospital is situated in one of its satellite hospitals called Sharoe Green Hospital. Sharoe Green Hospital was visited for two days to decide how the observations would be organised. After this visit it was decided to visit each sonography department for five consecutive days. Different clinics took place on different days in the hospitals and by attending the departments for five consecutive days it was adjudged that a full range of the sonographers work would be observed. From the experience gained undertaking the radiography observations it was decided to use an observational test tool. This was formulated before the preliminary visit to Sharoe Green and it was tested on the two day visit. After testing it was modified to produce the test tool shown in Appendix 11.

There were fewer sonographers than radiographers in each hospital, so it was not possible to shadow as many different sonographers as radiographers. At Sharoe Green Hospital there were six sonographers, at Blackpool three sonographers, at Lancaster three and at Furness Hospital four. The work patterns were different at each hospital with some sonographers working for a week in ultrasound followed by a week in general radiography. Sonographers saw fewer patients each day than radiographers. With the exception of 23 emergency cases that were observed all patients were seen on an appointment basis. In all hospitals, except Sharoe Green,

appointments were made every 30 minutes. At Sharoe Green the appointments were made each 20 minutes. As with the radiography observations, alternate examinations (examinations are termed scans in ultrasound practice) were observed, giving the researcher time to “write up” observations between patients. The number of sonographers and patients observed in each hospital is shown in Table 4.

| Hospital | Number of sonographers observed | Period of time each was observed | Number of patients observed |
|-----------------------|--|---|------------------------------------|
| Sharoe Green Hospital | 5 | 1 day each | 37 |
| Furness Hospital | 3 | 2 for 2 days each 1 for 1 day | 23 |
| Blackpool Hospital | 2 | 1 for 4 days 1 for 1 day | 28 |
| Lancaster Hospital | 1 | 5days | 24 |
| Total | 11 | 20 | 112 |

Table 4 Ultrasound observations by hospital

The researcher accompanied the sonographers into the examination rooms during each scan. The results of the sonographic observations were recorded on the observational tool sheets. As with the radiography observations a reflective diary was kept. At the end of each week of observation the notes made after each evening were written up. Much of the data contained in the reflective diary came from the discussions with sonographers between scans and from discussing issues with sonographers during rest periods such as tea and lunch breaks. The researcher initiated these discussions by asking how decisions had been made. Due to the nature of the examination the researcher did not stay in the examination room when trans-virginal scans were taking place. This only occurred on four occasions during the observations

5.6 The scope of sonographic decision making

To analyse the data in terms of the scope of decision making in sonography the same approach was used as with the radiography. A preliminary evaluation of the data was undertaken to identify groups of decision types. The decision groups were then tested against the data to establish if all observed decisions fitted into the groups. The groups that were identified during the preliminary evaluation of the data were:

- patient communication decisions;
- technical decisions;
- diagnostic decisions;

When these groups were tested against the data collected it was found that all the decisions that were observed could be classified into one of these groups. This classification was therefore used to group the data and to help determine the scope of decision making in sonography.

Patient communication decisions are a very prominent aspect of sonography decision making. The sonographer has intimate contact with the patient during a sonographic examination. The patient and sonographer view the images produced at the same time on the monitor. The sonographers were observed giving varying amounts of information to different patients. Some patients were given very little information even when they asked for it, while others were given full descriptions of the images on the monitor. Individual sonographers were also observed giving varying amounts of information to different patients. It was concluded that individual sonographers did not limit themselves to giving a similar amount of information to all patients,

rather the decision to provide information was based on judgements that the sonographers made of their patients.

Sonographers were observed giving diagnoses to patients. One patient was told that she was not pregnant but had a large ovarian cyst. Another patient was told that her liver looked normal. Other patients were given no diagnosis. Both good and bad diagnosis were given to patients. One woman who was on the Invitro Fertilisation programme was told that she was not pregnant.

During an examination to monitor a woman's ovarian follicles the patient said that she did not understand what she had been told by her doctor. The sonographer decided to explain the physiology of the ovary to the patient. The patient was also informed of the size of her follicles and how this related to her chance of getting pregnant.

On one occasion a sonographer was observed telling a couple that the foetus that the woman was carrying was dead. This occurred during an early pregnancy and the woman was told that the sonographer could not see a heart beat. When questioned further by the mother, the sonographer stated that in her opinion she thought that the baby had died. This scan had taken place in the first trimester of the woman's pregnancy. The woman had been referred by her GP for an ultrasound scan because she had experienced some bleeding. The woman's partner accompanied her to the scan. The woman asked what would happen to her and the sonographer said that she would send the report to a obstetric clinic that was taking place in the hospital and ring her GP. The patient asked questions regarding what would happen to "her baby".

The sonographer told the woman that she would see the doctor in clinic very soon and that that they would be able to answer all her questions. The sonographer explained the images on the monitor in some detail. An auxiliary nurse was called into the room and she accompanied this patient to the departments "quiet room". After this scan the sonographer took a break. She told the researcher that she felt that this was the most difficult part of being a sonographer. She stated that she did not like breaking bad news - but it was her duty to do so.

Technical decisions made by sonographers were observed in all examinations. Sonographers at all hospitals except Lancaster were seen deciding which examination rooms to take the patients into. At Lancaster there was only one ultrasound room. Different examination rooms had different equipment in them. Sonographers stated that some equipment was better than other equipment. On three occasions sonographers were observed making the decision to abandon the examination in one examination room and to move the patient to another room where they felt the equipment would give a better result. On another occasion an obese patient had to wait a considerable period of time (over one hour) because the sonographer decided that her examination would be better carried out on a piece of equipment that was in use by another sonographer.

Once inside the examination room the sonographers made technical decisions regarding the examination. These included which probes to use, what settings to use on the ultrasound machine and what hard copy (still images recorded on film, produced on laser printers) images to take during the examination. Sonographers also made decisions about using different techniques to obtain images. On four occasions

sonographers were observed proceeding from a trans abdominal examination to a trans-vaginal examination.

Diagnostic judgements were made in all observed examinations. All sonographers in all hospitals wrote reports on the examinations that they had undertaken. The sonographers made decisions regarding the content of the reports. These decisions were not simply descriptions of what they had seen or indications of abnormality (as with the red dot indications seen in the radiography observations). The sonographers indicated the specific abnormality that they judged was demonstrated during the scan. At Furness General Hospital the reports for abdominal scans were counter-signed by a radiologist after they had reviewed the hard copy images. In the other three hospitals the sonographers signed the reports.

The diagnostic decisions of the sonographers were sent to the referring doctors in the form of written reports. During one of the obstetric scans the sonographer judged that she had seen a foetus with a doliocephalic head. She decided not to mention this in the radiographic report because she felt that it would “send off too many alarm bells” in the obstetric clinic. In her opinion, this type of appearance often changed as the pregnancy developed. The sonographer in this case decided to call the patient back for another scan later in the pregnancy.

In summary, it would seem from these observations that the decisions made by sonographers can be classified into patient communication, technical and diagnostic decisions. The classes of decisions are inter-related, as are the judgements that are associated with these decisions. For example sonographers, make judgements about what they see on the images that they produce. These lead to diagnostic decisions that

are communicated to the referring doctor. This judgement is also used in patient communication decisions. The classifications groups of judgements identified do fit the observed data and give a greater understanding of the scope of decision making in sonography.

5.7 The scope of sonographic judgement

In all of the departments sonographers were observed making judgements during all the scans they performed. As with the observations of radiography the judgements that sonographers made were very closely associated with their decisions that they made. A classification of the judgement was developed after evaluation of the observational data. The classification of judgement was (as with the radiography classification of judgement) based on what the sonographers made judgements about.

The preliminary groups selected by the researcher were judgements relating to:

- examination requests
- patients
- images

The data was re-analysed using this classification, it was found that all the judgements observed could be arranged using the groupings identified.

Sonographers reviewed all the requests for ultrasound examination by referring doctors. The request forms included the patients' history and a request for a certain type of examination. The sonographers made judgements regarding the appropriateness of the examination requested. On two occasions sonographers were

observed deciding to undertake a trans-abdominal scan when a trans-vaginal scan was requested. When the sonographers were questioned about this they stated that they had judged that the information requested by the doctor could be gained adequately from the less invasive type of scan. On both occasions the sonographers also stated that the request had been made by a GP and that they judged that the doctor did not fully understand what they had asked for. If the request had come from a consultant they stated that a trans-vaginal scan would have been undertaken.

Sonographers were observed making many different judgements about their patients. These included judgements about the patients' ability to cope with information. During some scans very detailed information was given using medical terms, and during others very limited information was given using no medical terminology. During a first trimester scan of a 15-year-old woman the information was given using very simple terminology. When the sonographer was asked why she had decided to use that terminology she reported that she had judged that the woman would not be able to understand the description if more technical terms had been used. When questioned further to assert how this judgement was made the sonographer mentioned the woman's age and social background (based on address). During a scan to determine if a woman was pregnant who was undergoing infertility treatment, the same sonographer used very technical terminology. When questioned about this she said that women who were undergoing this type of treatment were very well informed and could understand technical descriptions.

Many examples of sonographers judging the physical condition of their patients were observed. Some in-patients from the wards on beds were examined on their beds rather than transferring them over onto the ultrasound bed. When asked about this, sonographers often said that they had judged the patient to be too ill to be transferred. In early pregnancy, patients have to be examined with a full bladder. Sonographers scanned patients and judged if their bladders were sufficiently full. When questioned about this judgement the sonographers stated that the decision was based on the ultrasound appearance of the bladder and a judgement about the ability of the patient to be able to take more fluid in her bladder.

Sonographers make two judgements about the images that they produce. The first is about the technical quality of the images that they are producing, both the dynamic monitor images and the still hard copy images. Sonographers were observed looking at hard copy images and stating that they were too dark or too light and then making adjustments to the printer. During other scans, sonographers were seen adjusting the ultrasound machine because they judged that the image was not detailed enough.

Hard copy images are produced in ultrasound but much of the diagnosis takes place from the dynamic image that is viewed on a monitor. The sonographers were observed making judgements regarding the technical quality of the images they were viewing and the diagnostic information that they contained. This was often observed to lead to changes in the setting of the ultrasound machine or the position of the probe.

As well as judging the technical quality of the images sonographers also made diagnostic judgements about the images that they were viewing. This type of image judgement was seen during all examinations. Images were judged on their pathological normality. All sonographers were asked about this. All said that their prime responsibility was to spot abnormality. When scanning they were asking themselves the question “is this normal?” If they judged that the image demonstrated abnormality then they went on to judge what the nature of the abnormality. This was different from the radiographers, who at most indicated that they did not feel that the image was normal – but did not go on to identify the abnormality. The sonographer’s judgements are more diagnostic in nature than the radiographers.

5.8 The nature of sonographic decision making and judgement

The decisions and judgements observed in sonography were closely linked. Decisions were observed that were based on more than one judgement. Questioning sonographers between patients about observed decisions revealed this. For example the decision to tell the patient the sex of the foetus. This decision was based on a number of factors. At Furness General Hospital it was the policy of the department not to tell the patient the sex of the foetus. At the other three hospitals the sonographers were free to inform the parents of the sex of the foetus if asked by the parents. Sonographers used different decision making tactics to inform the woman of the sex of the foetus. Some asked the woman if she wanted to know before they started scanning, while others only asked when they had almost finished the scan and

the sex of the foetus had been confirmed. Yet others did not ask the woman at all but waited to be asked.

During one observation, a sonographer at Preston Hospital asked a woman if she wanted to know the sex of the foetus after she had established it from the scan. The woman being scanned was hesitant in her answer to the question, but after some thought said that yes she would like to know the sex of the foetus. The sonographer told the woman that “the baby was laying wrong” and that the sex of the foetus could not be determined on this occasion. It was evident to the researcher that the sonographer could see the sex of the foetus. When questioned about this after the scan the sonographer stated that she had judged that the woman had not really given any thought to this question. In her opinion this information should only be given to patients who are positive that they want to know the sex of the foetus, so she had decided not to tell the woman the sex of the child. The researcher asked this sonographer if the decision to tell or not to tell was based on any other judgements. The sonographer said that the judgement was also based on how sure they were of the sex of the foetus. She stated that she had to be very sure of her judgement before she told the patient the sex of the foetus. All sonographers who were observed giving this type of information to patients always gave a warning that they may be wrong. At Blackpool Hospital the sonographers always told the patient that there was a 5% chance that they could be wrong. When the sonographers were asked where this number had come from they reported that it was from “the literature” but they could not remember where.

The decisions about the ultrasound report content were based on the judgements that the sonographers made about what they had seen during the scans. The main judgement was apropos the normality of the images that they had seen. During some scans the sonographers were seen taking measurements (the sonographers had to judge the correct place to take these measurements) and using known values to judge if the structure being scanned was within normal limits. An example of this was seen when sonographers were scanning livers. They took measurements of the common bile duct. Many measurements have to be made and the sonographer needs to judge where to take these measurements. Often a number of conflicting measurements were made and the sonographer decided which one to record. These measurements were compared with known normal values. This then had a major impact on what the sonographer decided to put in the report. During another examination to monitor follicle size a sonographer decided which of the follicles were of the most significant. During other scans the measurements were not made but judgements were made on the strength of the appearance of the scan. For example, one sonographer made a judgement that the scan did not demonstrate a pregnancy and this judgement had a major impact on what went into the report.

The different modes of decision making as cited in Hamm (1988) range from intuitive judgement to scientific experiment (see chapter 1). Decision making and judgement used by the sonographers included elements of all modes. Activities that sonographers were undertaking were often based on scientific experiment. For example, in first trimester scans, sonographers checked nuchal translucency. This is a test for Down's syndrome which is based on scientific research. However the predominant mode of decision making and judgement that was observed was

intuition. Many of the judgements and decisions that were observed were made very quickly. There was some evidence of peer aided judgement. For example, when scanning for a patient's liver a sonographer had problems getting a measurement of the common bile duct. After the examination the sonographer told the researcher that they were worried that the structure they had measured had not been the common bile duct. On this occasion another sonographer was asked to come and to have a separate measurement of this structure. The two measurements were compared and very closely agreed.

Another example of peer aided decision making was seen when a sonographer decided that a patient had 'retained products of conception'. Another radiographer checked this. A report was written for the referring doctor and the patient went and had surgery to remove the retained products. This illustrates another important aspect of the nature of sonographic decision making and judgement: they are often acted on by the medical profession and these have important consequences for the patient. The sonographers in all hospitals stated that termination of pregnancy was often carried out on the strength of the sonographer's report. They also reported that surgeons regularly operated on patients on the strength of an abdominal ultrasound examination carried out by the sonographer.

The sonographers did not make any overt attempt to use formal analysis in the form of decision aids. There was no evidence of tools such as decision analysis, data based aids or knowledge based systems being used. However, policy, protocols, guidelines and codes of conduct were an important aspect of all departments observed. The sonographers mentioned the policies and protocols that they were following often

when they were discussing their judgements and decisions. The departmental policies and protocols set down the procedures that the sonographers had to follow when scanning. For example, in obstetric scanning in all departments the protocols listed structures that had to be assessed by the sonographers. In all departments there were policies regarding how sonographers could communicate with their patients. Protocols were set locally in all but one hospital by the sonographers themselves. Radiologists, obstetricians and sonographers set policies. At Furness General Hospital, the protocols and policies had been set solely by the radiologist.

The interaction of sonographers with protocols and policies is noteworthy. It seemed that the sonographers were acting in a professionally autonomous manner in most decisions while interacting with departmental policy they did not seem to be blindly following this policy. This interaction with policy and protocol was most evident in the departments where these had been developed in partnership between obstetricians, radiologists and sonographers. The sonographers in all departments stated that they saw departmental protocols and policies as guidelines and they felt that they could be interpreted in a number of different ways. They did not feel that they were totally constrained by the policy.

At Furness Hospital where the policy and protocol had been set by the radiologist, the sonographers were to some extent constrained. Sonographers felt very little ownership of the policy. In this hospital, general abdominal examinations were either carried out by a radiologist who also reported the examination, or a sonographer carried out the examination and then the films that were produced were reported on by a radiologist. There also seemed to be some tension regarding what they were

allowed to tell the patient in this Hospital. This was defined by the radiologist. Sonographers in this hospital were not allowed to give the patient information about the diagnosis that they had made or tell the patient the sex of the foetus.

The College of Radiographers and the Council for the Professions Supplementary to Medicine set national policy in the form of professional codes of conduct. Both these organisations were set up with radiography as their primary focus, and hence their codes of conduct written with respect to the radiographer. There have been changes made to these codes of conduct which make reference to ultrasound. Sonographers stated that the codes of conduct were important and they all said they had to work within these codes or risk being removed from the professional register. These codes of practice are reviewed in chapter one in section 1.4.

5.9 Comparisons between decision making and judgement in radiography and sonography

The classification devised for radiography and sonography decision making and judgement is shown in Table 5:

| | Radiography | Ultrasound |
|-------------------------|---|---|
| Judgement groups | 1) Examination request judgements 2) Patient judgements 3) Radiographic image judgements | 1) Examination request judgements 2) Patient judgements 3) Image judgements |
| Decision groups | 1) Managerial decisions 2) Educational decisions 3) Technical decisions 4) Communication decisions | 1) Patient communication decisions 2) Technical decisions 3) Diagnostic decisions |

Table 5 Classification devised for radiography and sonography decision making and judgement

Both radiographers and sonographers make judgements and decisions. There are many factors that are common to both groups of health care professionals. Both groups of professionals make judgements and decisions concerning medical images they produce and the patients that are being imaged. Both groups make technical judgements about the images that they are viewing and make decisions based on these decisions. In the case of radiography the images being judged are hard copy (radiographs) whereas the sonographers make judgements of dynamic images (monitor images). The decisions based on these judgements are similar in nature with both involve changing "exposure" factors or not. In the case of radiographers examinations are repeated or not using different exposure factors and in ultrasound the exposure factors are changed during the course of the examination.

Both groups of professionals make judgements about their patients' physical condition and make decisions based on these judgements, such as how to examine the patient and what exposure factors to use. They also judge their patients socially, emotionally and psychologically and use these judgements to decide how to interact and communicate with their patients.

Both sonographers and radiographers undertake their professional practice in accordance with local policies and protocol and nationally agreed codes of conduct. In some respects these constrain their professional practice, but both radiographers and sonographers were observed to have some discretion in how these factors are interpreted.

The major difference between the sonographers and radiographers is that sonographers report on the images that they produce and the radiographers observed in this study do not. Although the radiographers did indicate referring to the doctor that they felt an abnormality was demonstrated (red dot), this cannot be considered a diagnostic judgement. Sonographers on the other hand did make a diagnostic judgement and used this to write a report on the image. This report included an indication of what abnormality the sonographer felt was demonstrated. In radiography this role is taken by the radiologist. In sonography the judgements and decisions made can have a profound impact on the patient. This is not often the case in radiography.

A second area where radiographic and sonographic practice is different is the amount of information that is given to the patient. In radiography some radiographers were observed giving very modest information to the patient about their condition. In radiography this was confined to A&E radiography where some patients were told that they had a fracture or not. In sonography patients were routinely given a diagnosis. When questioned about this aspect of their work both sonographers and radiographers found this problematic. Both groups stated that they felt constrained by their professional codes of conduct. Some sonographers also felt ill at ease with breaking bad news because they stated that they saw it as part of their role but that they had not really been taught how to undertake this role.

5.10 How the survey and observations related to the interview phase of the research.

The next stage of the research focused on investigating the second of the research questions “How do imaging professionals make judgements and decisions” and “can decision analysis be used as a research tool”. For this part of the research an in-depth interview technique was used. The researcher decided to focus the research on one particular professional group and to focus on a particular decision that is made by this group.

As a result of the observational phase of the study sonography was chosen to study in more detail. This decision was made because it was felt that the decisions and judgements made by sonographers were of more importance to patients. Sonographers are also a relatively new professional group who are emerging from within radiography. They are establishing professional boundaries that would be interesting to investigate. Because this group is in the process of establishment it was judged that the decision and judgement making processes might be more overt.

The judgement and decision that was chosen related to the breaking of bad news, in particular how the sonographer decided what to tell the patient when they discovered that there was an abnormality of the foetus present while undertaking an obstetric scan. This particular problem was chosen because many sonographers had reported that this was the aspect of their work that they found most problematic. They felt that it was hard to break this kind of news to patients and that their education did not prepare them for this task. They also felt that the national codes of conduct that they worked under were not always clear on this matter.

Chapter 6

Interviews with key informants – policy makers in ultrasound

6.0 Introduction

The second research question, “how judgements and decisions are made” was addressed in the next stage of the study which used in-depth interviews to collect data for analysis. The research question “Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?” was also addressed in the interview stage of the research. These questions were answered by focusing the research on one professional group (sonographers) and a particular judgement and decision making issue (breaking bad news to patients) within that group.

Chapter 5 discussed the selection of sonographers as the focal group for the study as a result of the observational stage of the study. The area was chosen because during the observations it was found that within ultrasound departments clinical judgements and decisions are made that are:

- sufficiently complex to test the use of decision analysis as a research tool;
- involve controversial issues which would engender discussion about the judgement and the decision making process;
- judgements and decisions that some sonographers find problematic.

Judgements and decisions relating to the breaking of bad news were also selected because the national codes of practice, issued by the College of Radiographers (COR) and the Council for the Professions Supplementary to Medicine (CPSM) impacted on them. These codes of practice are discussed in chapter 1 section 1.4. During the observations, sonographers reported that these codes of conduct were an important consideration for them when they were considering what to say to patients. Because of this it was decided to interview two people who were influential in the organisations that had formulated and developed these codes. This part of the research had two major objectives, the first methodological, to establish if decision analysis could be used as a tool to structure research interviews, and the second to address the research question "how do professionals make decisions". By investigating how those who are influential in the formulation of national policy in this area, it was hoped to develop a greater understanding of professional judgement and decision making at a policy level.

During the observational stage of this study, sonographers often referred to their sonography education when questioned about their judgements and decisions. When asked why they had made certain judgements and decisions they sometimes stated that it was because of what they had been taught. At the time of the research, the researcher worked in a University department which delivered a post graduate diploma and masters degree in sonography. He therefore had easy access to sonography educators. From the observations, it seems that ultrasound educators influence clinical sonographers and their decision making and judgement. For this reason it was decided to interview a sonography educator.

6.1 Interviews using decision analysis

6.1.1 The participants

The COR is the professional body of radiographers. It issues a professional code of conduct that has references to ultrasound and it regulates the use of ultrasound by radiographers. The COR was set up by and is run by radiographers. Its primary goal is to safeguard the interests of radiographers including those who practice radiography. In recent years other health care professionals such as midwives have become involved in the use of ultrasound. Because of this a new body called Council for the Accreditation of Sonographic Education (CASE) was set up to regulate ultrasound education. One of the main members of CASE is the College of Radiographers. Another multi-professional body that has been set to advance the use of medical ultrasound is the British Medical Ultrasound Society (BMUS).

The researcher decided to interview the President of the COR who for the purposes of this study will be called Jane. This decision was made because Jane served on all committees within the COR and this meant that she would be fully aware of current COR policy and thinking in relation to ultrasound. Jane was also a qualified sonographer. She was contacted and agreed to be interviewed. At the time of the interview Jane was also a COR representative on the governing body of CASE. At the time of the research interview she was 48 years old and was married and had no children. She worked in a University in the South of England as the Head of the School of Radiography. She has

not undertaken clinical sonography for the past 15 years but was heavily involved with ultrasound education both at her own university and at others in an advisory capacity.

The CPSM is a statutory body established to regulate the activity of professions that are supplementary to medicine. It holds a register of all qualified radiographers. Although there is no separate register for sonographers, all radiographers working in this field have to be state registered. The council is charged with guarding the rights of the patient. It should be noted that the prime goals of the COR and CPSM do differ in that the COR is practitioner focused and the CPSM is patient focused. The CPSM publishes a code of practice that makes reference to ultrasound. It does have the power to discipline practitioners and to remove radiographers and sonographers from the register. Once removed from the register, sonographers and radiographers cannot practice in the NHS in the UK. They would also find it difficult to work in private practice. The section of the CPSM, which regulates the activity of radiographers, is the Radiographers Board. The Radiographers Board is made up of a majority of elected radiographers and is chaired by a radiographer.

As with the COR a decision was made to attempt to interview the leader of the organisation, in this case the Chair of the Radiographers Board (CRB) who for the purposes of this study will be called Peter. This was done because Peter also sat on the central CPSM so would be aware of policy and current thinking of the CPSM in general and the radiographers board in particular. Peter also chaired the disciplinary committee of

the Radiographers Board, this committee deals with issues concerning infringements of the code of conduct.

Peter was contacted and agreed to be interviewed. At the time of the interview Peter was a 56-year-old male radiographer. He worked as a Radiography Manager in a teaching hospital in Wales. He is not qualified in sonography but has managerial responsibility for a department that includes ultrasound. He is married with two children and two grandchildren.

The ultrasound educator was the course leader for a post graduate diploma and masters course in medical ultrasound at the University College of St Martin in Lancaster. He will be called Paul for the purposes of this research. At the time of the interview he was 47 years old and was married with two school age children. Paul was a qualified sonographer and had worked both as a clinical sonographer and departmental manager before taking up post as a senior lecturer. At the time of the interview Paul was actively involved in ultrasound research, which involved him undertaking clinical sonography on a weekly basis.

These interviews provided a depth of understanding about national policies and protocols in place at the time of the research and how the people who were instrumental in their formulation went about decision making. It was also hoped to establish how an experienced sonography educator went about making decisions and judgements in this area. It was important to pursue this because observational data indicated that educational

processes influenced decision making and judgement. The interviews with the policy makers were also a chance to address research question regarding the use of decision analysis as a research tool.

6.1.2 Method

The following scenario was written for use in the interviews. It was based on the observations made of sonographers. Although not observed directly by the researcher, sonographers in the ultrasound departments in this study stated that they had to deal with similar scenarios regularly in their work.

You are working in an ultrasound department. At the midpoint in your morning's list of routine 18-week obstetric scans, you discover that the foetus you are scanning is dead in the uterus. You have to decide either to tell the woman about the death of her foetus or not. There is the chance as with any test that you could be wrong. If you tell her there is also the chance that she will get very upset in the ultrasound room. There is also the chance that if you do not tell her she will suspect there is something wrong and become very worried and have no information until she visits the clinic. This decision can be shown on the following decision tree.

A decision tree shown in Figure 8 was also developed to fit this scenario. It was designed to promote discussion rather than to be the “correct” model. The aspects of the tree that were designed to promote discussion were the titles used to describe how the woman coped with the information if given and the “unbalanced” nature of the tree. If the tree was complete and balanced then terminal nodes U5 and U6 should be chance nodes followed by branches from each node for “foetal death” and “no foetal death”.

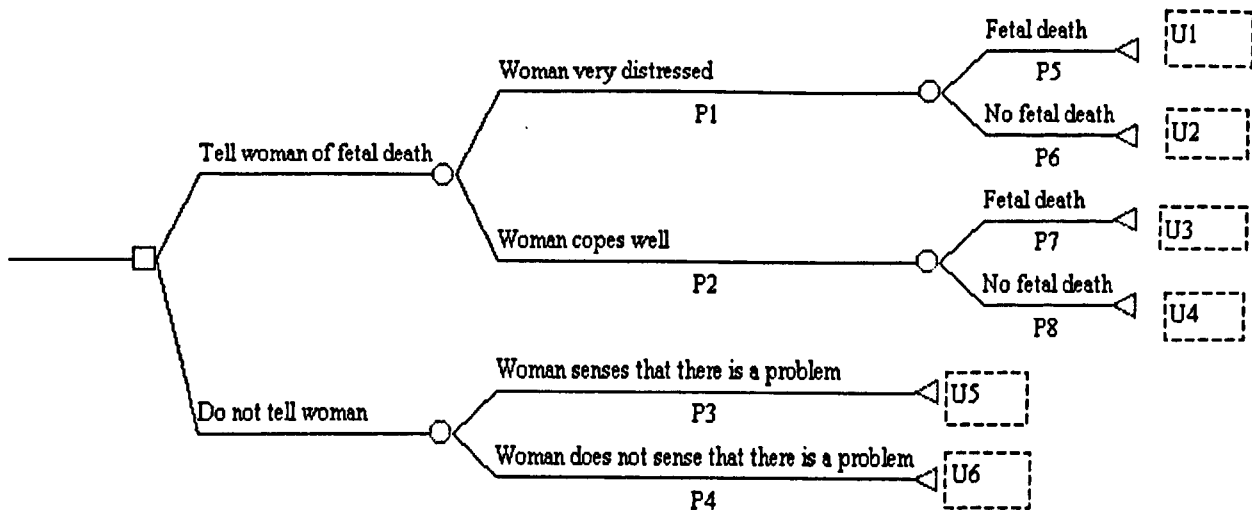


Figure 8 Decision tree used for interviews with influential people

Where

U1 = Utility of woman who is given correct information and is very upset

U2 = Utility of very upset woman who is given wrong information

U3 = Utility of giving the information and woman returning to clinic
Information is correct

U4 = Utility of woman coping well but who is given the wrong information

U5 = Utility of sending a worried woman back to clinic. Allowing
clinic staff to break the news of death. Will be some delay

U6 = Utility of sending woman back to clinic. Allowing clinic staff to
break news to patient who is unaware of patient

Each of the three participants was interviewed separately. The interviews lasted for approximately two hours each. Both Jane and Peter indicated that they regularly travelled around the UK, so the interviews were arranged to take place in Lancaster at the

researcher's place of work at a time that was convenient to the participants. The sonography educator was also interviewed at the researcher's place of work. The educator was interviewed in April 1996, Jane in May 1996 and Peter in June 1996.

At the beginning of each interview the participants were informed that the researcher was undertaking research as part of a PhD, and that the research was investigating how sonographers make judgements and decisions. They were informed that during the observational stage of the study it had been concluded that the codes of practice issued by their respective organisations impacted on sonographers' decision making. The educator was informed that sonography education also seemed to impact on the decision making and judgement of sonographers. They were also informed that the researcher wanted to interview them about how sonographers should make decisions and that he was going to make use of a technique called decision analysis to structure the interview. They were asked to answer the questions from the perspective of the leaders of their particular organisations and in the case of the educator, as an educator.

For ethical reasons the participants were also informed that they would not be mentioned by name, but that their identity could not be completely hidden in the report of the research that may be published. The researcher explained that because of their position it would be possible for an interested person to establish their identity. All three participants reported that they understood this and were not concerned about this. They all agreed to take part in the research.

The process of decision analysis was described using a simple example and drawing a simple tree. While working through the simple example the main concepts of chance, utility and expected utility were explained. The decision scenario and the decision tree described previously was given to the participants and they were then asked to add probabilities and utilities to the tree. Once this had been done the researcher calculated the expected utilities for the tree and these were shared with the participants. The process was then discussed with the participants and they were asked their opinion of decision analysis. They were also asked if they thought that decision analysis could be of practical use in ultrasound practice. General issues of breaking bad news in ultrasound practice were also discussed with the participants. During the interviews, the researcher took notes and these were "written up" on computer by the researcher on the day of the interview.

6.2 Interview with Ultrasound Educator - Paul

6.2.1 The scenario and structure

Paul felt that the scenario was true to clinical practice and stated that he had been in this situation on a number of occasions. Paul had reservations about the structure of the decision tree. He felt that the tree was simplified and there were other options open to the sonographer with regard to giving the patient this bad news. He noted that the structure of the tree did not allow the decision-maker to give partial information, evaluate the patients response and then make another decision about the patient's reaction to the partial news. Paul also felt that any departmental protocols would have a major influence on the

sonographers decisions. Paul also noted that this type of ultrasound scan often takes place with the patients' partner present. The relationship between the patient, partner and sonographer can have a bearing on the information that is given. With these reservations noted, the sonography educator did undertake the decision analysis task. Paul had no difficulties in undertaking the decision analysis. He told the researcher that he had come across the technique before but had never used it.

6.2.2 Utilities and probabilities

The utilities and probabilities assigned by the educator are shown in Table 6 on page 170. Paul felt that some of the descriptions of the outcomes were framed in a way that made assumptions that in practice may not be correct. He was particularly concerned about the descriptors for the emotional state. Paul felt that outward signs of distress could not judge a woman's emotional state. Paul made reference to a case that he had been involved in where a patient had been told that her foetus was no longer alive. She went completely silent and would not respond to support given by departmental staff. He felt that this was the most emotionally distressed patient he had ever dealt with but overtly she had not shown any signs of "being up-set". Because of the participants familiarity with decision analysis he had no difficulty in assigning probabilities to the decision tree.

6.2.3 Paul's reflection on the process

The expected utilities for the decision were calculated. These were EU tell patient = 88 and EU do not tell patient = 4. Paul agreed with the outcome of the decision analysis. He felt that it was right that women should be told of this diagnosis at the earliest possible

opportunity. He stated that he felt that it is a woman's right to know, and even if she is not told she will sense that there is a problem. He did come back to the issue of departmental protocols and stated that sonographers may also feel this way but they may not be allowed to give this type of information because the departmental policy stated that they could not.

He went on to say that he felt that this was a very difficult part of the sonographers' work. He felt that some sonographers managed to avoid giving this type of information to patients and they kept the information to themselves. In practice he estimated that about half the sonographers that he knew gave this type of information and half did not. Of those that did not give the information many gave partial information.

Within the context of the ultrasound courses that he delivers, students are advised that they should give patients this type of information if it is within the remit of departmental policy and protocols. He further stated that this advice was not given in a "simple" way. Students were advised to consider the support that they could give the patient after the news was given and also to consider if they could answer the questions that would inevitably come after such news is given.

Paul was concerned about the simplicity of the situation outlined in the scenario. He stated that he had worked within the confines of the tree but felt that he would have liked to put extra options and branches onto the tree.

Paul was interested in decision analysis as a teaching tool. He felt that it could be used to demonstrate situations to students and illustrate various outcomes to different courses of action. He also felt that the techniques could be used to “debrief” students after clinical practice. He did see decision analysis as a tool that he could use to develop reflective practice in his students. He stated that undertaking the decision analysis had made him think about the issues in more detail than he had before.

Paul found it difficult to see how decision analysis could be used in practice. He felt that the time for making these decisions is too limited to undertake such an exercise. Even if there was time Paul felt that it would not be good patient care or instil confidence if the sonographer undertook a decision analysis to make decisions.

6.3 Interview with the Chair of the Radiographers Board - Peter

5.3.1 The scenario and structure

Peter who works as a radiography manager was asked to comment on the structure of the decision tree. He felt that the structure of the decision tree seemed realistic and that sonographers made similar decisions in their professional practice. He commented on the fact that the patient could be sent back to the clinic and the diagnosis made by the radiographer could still be wrong. It was explained that the decision tree could have been made much more complex - but in this case was being used to investigate the immediate consequences of a decision. Overall Peter was willing to accept the scenario.

6.3.2 Utilities and probabilities

The utilities and probabilities assigned by Peter are given in Table 6. Once explained to him, Peter seemed to understand the concept of utilities. Peter was asked to assign values to the outcomes seen in the given decision tree. He did this by first assigning values to what he considered to be the “best” and “worst” outcomes. He then valued the other outcomes in relation to these “best” and “worst” value for outcome A.

He felt that the best outcome was when the radiographer told the patient her diagnoses (foetal death) which was accurate (true positive) and the mother did not get distressed by the news. He thought that this was the best outcome because in his view it was best to tell the patient at the first possible opportunity, and in this case it was the correct diagnosis. He also stated that this was the best outcome because it would enhance the image of the department because the sonographers would be seen to be acting more professionally. When questioned further on this he stated that he did not feel that it was very professional for sonographers to “pass the buck” of breaking bad news onto other health care professionals. He also felt that by being open with the patient there would be an increase in trust between the patient and radiographer. He also thought that this was the best outcome because the radiographer could give the patient support at the earliest possible opportunity.

Peter felt that the worst outcome was when the radiographer did not tell the patient the diagnosis and the patient sensed that there was a problem. He felt that this was the worst

outcome because the patient would be stressed for some hours, if not longer, while she waited for their suspicions to be confirmed. He also felt that the patient may have false hope. He was also concerned that there may be no chance for the patient to see the foetus on the scan if the news is given second hand. He also felt that the professional standing of the sonographer and the imaging department may be diminished.

Peter considered that there may be legal issues for "Outcome 2" (Utility of very upset woman who is given wrong information). It could also mean that the pregnancy could be terminated by an abortion. Peter went on to say that in many cases he thought that this may well happen and there would not be a legal problem because the viability of the foetus would never be discovered, i.e. sonographers False Positives would not be found. For "Outcome 4" he also commented that there were legal implications and the pregnancy could be terminated. He also pointed out that in many hospitals a second scan would be performed to confirm the diagnosis. For "Outcome 6" he felt that this has a fairly good outcome with no real harm being done to the patient. He did however feel that there would be harm done to the professionalism of the radiographer. He felt very strongly that this approach was not professional and was treating the patient as of secondary importance to the examination. It was also thought that if this was the routine procedure there would be a loss of job satisfaction.

Peter understood the application of probabilities to the decision tree. Peter thought that the probability of the radiographer getting the diagnosis wrong in this case would be very small. He felt that if there was "any doubt" in the radiographers mind then they would not

inform the patient of the diagnosis. The chance of the radiographer getting the diagnosis wrong was put at only 0.01%. He thought that the chance of the woman being distressed at the diagnosis was 80%. He thought that 90% of women would sense that there was a problem if they were not informed of the diagnosis.

6.3.3 Peter's reflection on the process

The expected utilities for the decision analysis were calculated. These were EU tell patient = 92, and EU do not tell patient = 5. The participant stated that this agreed with his intuitive decision on this scenario - in practice if he was the sonographer he would tell the patient. He was a little surprised at how much difference there was between the two expected utilities.

Peter stated that he found it difficult to assign the utilities because he was unsure whose utilities he should be considering. He felt that the outcomes would be valued differently if a legal, professional or a patient centred approach was taken. He thought that he was taking a patient centred approach as was proper for Peter. As well as being Chair of the Radiographer's Board, Peter was also a departmental manager He stated at points he felt that he may have assigned different utilities if he was operating in this mode rather than as Peter.

Overall, the participant reported that he had enjoyed the experience of undertaking the decision analysis and it had motivated him to reflect on this decision. The participant also mentioned that there had been a case in his hospital where a doctor had made a mis-

diagnosis in this area of ultrasound. This exercise had made him re-consider his views on this occurrence.

6.4 Interview with the President of the College of Radiographers – Jane.

The same scenario and decision tree was given to Jane as was given to the other two participants. Two hours were allocated to this session. She learnt the concepts of decision analysis very quickly. The participant seemed reluctant to undertake the decision analysis during the session. She stated that she needed more time to think about the situation. The participant was much more inclined to discuss the scenario and the technique of decision analysis. During the session she managed to complete the analysis, but was unwilling to state that this would be her final analysis of the situation. She wanted to take the exercise away with her so that she could reflect more on the techniques and her part in it. This she did and the decision analysis was returned with comments a month later. The following account is based on observations made at the initial session and comments that were returned by the participant.

6.4.1 The scenario and structure

Jane considered the scenario to be realistic, but felt that she wanted to know if this was the woman's first scan or a follow up scan after an equivocal first scan. From Jane's experience she felt that often women would be re-scanned without them being given full information regarding the reasons for the re-scan. After some discussion she decided that

she would undertake the exercise on the assumption that this was the woman's first scan and that the findings were unequivocal.

Jane did not like the classification of the emotional state of the patient as "very upset", "copes well" and "worried". She felt that this was over simplistic and the terms used on the decision tree were more relevant to the overt behaviour of the patient rather than her emotional state. Jane believed that many patients who were overtly very upset were coping well with the situation. Other patients who seemed to be "coping well" were emotionally in turmoil.

6.4.2 Utilities and probabilities

The utilities and probabilities assigned by Jane are shown below in Table 6. The participant understood the concept of assigning utilities. The only indication that there may not have been full understanding was that in the written feedback she gave the utility values using a % sign. This could have been a simple mistake in the use of units or a major lack of understanding. The utility values assigned to a group of outcomes did not add up to 100, so it was clear that utility values were not being used in the same manner as probability values by this participant. She did not have difficulty in assigning utilities to the various outcomes.

In the written feedback Jane commented on all outcomes. It appeared that the participant added information to the descriptions of the outcomes that were given in the decision trees. In relation to other outcomes the participant seemed to perceive the definitions of

outcomes in two different ways. She then indicated that one of her meanings was used for the purpose of assigning probabilities. For example in relation to “Outcome 6” she commented that she is assuming that the anti-natal clinic to which the woman is being referred

“is not frantically busy and appropriate staff are there.”

Jane also added information to the tree in terms of environmental factors. When she considered Outcome 6 she stated:

“It is not beneficial to a busy, cramped department to have to deal with very distressed woman”.

This information is not given in the scenario or the tree. Jane seems to be adding information to put the decision into context. This could be an artefact due to the fact that she took a month to respond rather than completing the analysis at the time of the interview.

Jane did not have any difficulty in understanding the concept of chance and probability related to decision analysis. Probabilities were assigned to all probabilities on the decision tree. When assigning probabilities to the decision tree it became clear that the participant was ensuring that the probabilities on branches after a chance node added up to 100%. This would indicate an understanding of this aspect of decision analysis.

Jane felt very strongly that the sonographer would only tell the patient these bad diagnoses if there was 100% certainty it was correct. Because of this she did assign values of 100% and 0% chance to some chance branches. She did however state that

“infallibility is impossible” and at this point added a further estimate of chance in parenthesis.

6.4.3 Jane’s reflection on the process

The expected utilities for the decision were calculated. These were EU tell patient = 80 and EU do not tell patient = 30. Jane indicated that the decision analysis agreed with her intuitive decision when she first read the scenario.

Jane stated that:

I found the task very hard and emotionally demanding. I found that it made me face conflicts between my role as a “caring professional”, as a “harassed and busy professional under pressure”, a potential patient or a relative of a patient (woman) and as a person who might well prefer to skate over the nasty parts of life.

Jane stated that she had spent a great deal of time on this decision analysis. It is evident from this statement that she had found the decision analysis demanding. Even though this participant was asked to take part in this research because of her position as President of the College of Radiographers it is evident that she found the task challenging because of her varying professional roles.

Jane was surprised that the expected utility for not telling the patient had scored so highly. She felt that her intuitive feeling for taking this course of action was much stronger. Jane felt that sonographers should always give this type of information and that it was the patients “right” to know this information. Jane was asked to reflect on the decision analysis and comment on why the value for not telling the patient was so high.

She did this and felt that it was because she had given such high utility to Outcomes 5 and 6. She said she had done this for these outcomes because:

“Although this is a very poor situation for women and for the sonographer, it may be useful for the sonographer in that it gets the woman out of the department/off his/her hands. Pragmatically this enables work in ultrasound to continue - although the quality of continuing work could be hampered.”

Jane was shocked at this realisation because she felt that she was a “patient centred” practitioner and she did not realise how much departmental management and workflow seemed to influence her decision.

6.5 Reflection on this stage of the research

This stage of the research demonstrated that decision analysis could be used to structure research interviews and hence is used as a research tool. Although only one of the participants (the sonography educator) was familiar with decision analysis all were able to learn the basics of decision analysis within the time frame of a two-hour interview. This conclusion is drawn from the feedback given by the participants during the interviews. For example the participants realised that the probabilities after a chance node must add up to $p=1$. They also added utilities that did not summate to 1 or 100. This indicates that they understood the difference between probabilities and utilities. Participants understood the concept of expected utility and could relate the expected utilities of their decision analysis to the outcomes of their own intuitive decision making.

None of those interviewed noted that the decision tree that they were given was “unbalanced” and that it did not include all the logical outcome nodes. Chance nodes were not included where the terminal nodes U5 and U6 are located. This may indicate that those interviewed did not have an in-depth understanding of the whole decision analysis process. After the interview the participants may not have had the knowledge and skills to undertake a decision analysis independently, but they were capable of being guided through a decision analysis within the confines of the research interview.

All participants felt that the basic scenario was realistic and was one that occurred in clinical practice. All felt that the decision tree simplified the decision making and wanted more information such as what tests the woman had had before this scan took place and had the woman already had an indication that there may be a problem with her pregnancy. They also wanted more environmental information such as the size of the examination room and the workload of the department. When the participants asked this type of question they were told that this information was not available. During this part of the research there were many instances where the participants seemed to provide the information for themselves i.e. they invented information. The participants seemed to be happier doing this than working on the decision analysis without this information.

Evidence of the participant providing information themselves which was not included in the scenario is provided from the interview with Peter. Where Peter did not feel that the scenario was complex enough he added complexity, drawing on practical experience from his own hospital. For example, he gave environmental factors such as the size of the

scanning room and the chances of counselling the patient in relation to this. He made assumptions regarding the treatment of the woman after the scan. He assumed that the woman would be given a follow up scan because this is the routine in his own hospital. A number of these assumptions had a bearing on the utility that was assigned to an outcome. When the scenario was developed the researcher assumed that the outcome which stated "Utility of sending a worried woman back to clinic...." involved the woman being seen in the clinic within the hour. Peter (because of working practices in his own hospital) thought that this would mean that the woman would not be seen in clinic for a matter of days.

Even though the participants were requested to undertake the decision analysis from the perspective of the leader of their respective organisation or as a sonography educator all found this difficult. Participants felt that they could undertake the analysis from the perspective of the patient, the sonographer, department manager, and "the profession". Peter also felt that the decision analysis could be undertaken from a legal perspective. At no time did any of the participants indicate that they were considering the perspective of the foetus. It could be argued that in their official roles Jane should most appropriately consider the decision from the sonographers perspective and Peter from the patients, as the main goal of their respective organisations is to safeguard the interests of the professional and the patient. The Sonography Educator did identify educational applications for decision analysis at the end of the session.

All indicated that even though they had been requested to consider the problem from their “role” position, all indicated that they had undertaken the decision analysis from the patient’s perspective. None of the participants indicated that they would try to elicit the patient’s utilities for the various outcomes, or on reflecting on the process as a whole thought that this would be a worthwhile exercise. They were using their own estimates of the patient’s utility rather than indicating that they would try to establish the patients own utility. Two of the participants were men and the other a woman with no children but they still all felt capable of assigning utility values for a female patient who was 18 weeks pregnant.

An example of difficulties that the participants had with perspective was seen during the interview with the educator where he stated that:

“I am not sure whether to undertake this from a diagnostic accuracy or a patient support point of view”

When asked what he meant by this he stated that the decision could be looked at from the practitioners’ perspective that is primarily concerned with diagnostic accuracy or from a patient support perspective. The educator equates the practitioners’ role with diagnostic accuracy rather than patient support. When assigning values he was not sure whether to give the highest values to the outcomes, which gave the best emotional support for the patient, or would lead to the best diagnosis. He felt that Outcomes 1 and 4 were in conflict from the two different perspectives.

Peter also had problems with perspective. He did state when he first identified this issue that as Peter he felt that he had to give a patient’s utility. He did not perceive any

problems in assigning the utilities on behalf of a pregnant woman in this situation. Peter did, however, consider the utilities of the sonographer and of the profession were considered, but at no time was the utility of the foetus mentioned.

Jane also found that she had to undertake the decision analysis from a particular perspective. She found that the decision analysis had made her face the conflicts between her various role. It is evident from the language used (“*very hard and emotionally demanding*”) that she found it an exacting process. The participant indicated that she had decided to undertake the decision analysis from the patient’s perspective. At the end of the exercise she was surprised by the expected utility for the decision route that she would not have taken. It seems that the participant made a decision to undertake the decision from one perspective, but subconsciously another perspective influenced the process and the decision analysis was judged from the original perspective.

From the evidence collected during this part of the research it is thought that the representatives from the COR and CPSM could not separate their roles as leaders of their respective organisations from other roles. All indicated that they were undertaking the decision analysis from the patients’ perspective but from observing them performing this task it was evident that a number of perspectives were influencing them. The sonography educator also stated that he was primarily undertaking the decision analysis from perspective of the patient. It is also probable that other factors such as clinical experience gender and age influenced how the participants performed this decision analysis.

Another issue that became evident from this part of the research was how the participants regarded the sonographer's level of certainty at which they would break bad news to a patient. Peter made the following statement regarding the giving of bad news in cases like this:

If the sonographer was in any doubt about the diagnosis then they would not tell the patient about the intrauterine death - they would have to be certain.

This would suggest that he felt that there is a link between the utility of an outcome, the probability assigned and the final decision made. From the statement it would seem that these components are not related in a manner suggested by decision analysis. The participant seems to feel that if the utility value is great (in this case negative) then the decision to give bad news will only be given if the sonographer perceived that their diagnosis was 100% correct. In practice sonographers should never be 100% certain of their diagnosis. Either the participant is incorrect in his generalisation about the decisions made by sonographers or sonographers do not acknowledge that they can make misdiagnoses. If the participant's statement is correct and sonographers do understand the nature of probability they would never give this information to their patients. It is known from the observations that sonographers do give such news to their patients, so there is some threshold probability at which point sonographers do give this type of information to their patients.

Jane also stated that she felt that the sonographer would only ever tell the patient this bad diagnosis if the finding were "*unequivocal*". Like Peter this indicates that she feels that if

the utility of a False Positive is very great (negative) then the decision to give bad news will only be made if the sonographer perceived that their diagnosis was 100% correct.

On the basis of the observation of the decision making process and the written feedback from Jane, all those interviewed found the decision analysis exercise to be a very enlightening process - one which made them think in detail about what they were doing. Being leaders within the field of sonography it is remarkable that the participants found new insight by undertaking the decision analysis. This insight seems to originate from the fact that decision analysis makes all issues overt, even ones that the practitioner may wish to remain hidden.

The probabilities and utilities assigned by the three participants and the calculated expected utilities are given in table 6.

| | Chair of CPSM | President COR | of Sonography Educator |
|--------------------|--------------------------|--------------------------|---------------------------------------|
| P1 | 0.8 | 0.98 | 0.2 |
| P2 | 0.2 | 0.02 | 0.8 |
| P3 | 0.9 | 1.0 (0.999) | 0.97 |
| P4 | 0.1 | 0.0 (0.001) | 0.03 |
| P5 | 0.9999 | 1.0 (0.999) | 0.95 |
| P6 | 0.0001 | 0.0 (0.001) | 0.05 |
| P7 | 0.9999 | 0.99 | 0.9 |
| P8 | 0.0001 | 0.01 | 0.1 |
| U1 | 90 | 80 | 60 |
| U2 | 20 | 0 | 0 |
| U3 | 100 | 100 | 100 |
| U4 | 30 | 4 | 20 |
| U5 | 0 | 30 | 0 |
| U6 | 50 | 60 | 40 |
| EU Tell | 92 | 80 | 88 |
| EU Not tell | 5 | 30 | 4 |

Table 6 Probabilities, utilities expected utilities assigned by influential people interviewed

In terms of magnitude there were some significant differences between the probabilities assigned by the participants. For example the difference of a factor of 10 for the probabilities assigned for probability P2 by the Chair of CPSM and the President of COR. There are also large differences for P6 and P8. These differences may have come about because the participants had difficulties in expressing very low estimates of chance. All participants may have had the same verbal descriptor of a low estimate i.e. “very very small chance”, but each assigned different absolute probability values for these estimates.

There is a noteworthy difference between a probability set by the sonography educator and the other two participants. He felt that there is a greater chance that when told the information the woman will not be distressed in the short term ($p=0.8$) rather than be very distressed ($p=0.2$). This contrasts with the other two participants who felt that there was greater chance ($p=0.8$ and $.98$) that the woman would be very distressed than not be distressed in the short term ($p=0.2$ and 0.02). When asked to comment on this the sonography educator stated that he assigned this probability because he felt that in his experience most patients in this situation had some idea that there was a problem with the pregnancy before attending for the scan. This information had not become evident until this line of questioning took place. This difference in probability assignment is distinct from the previous one described. Here the participant has an opposite perception of how patients will react, rather than a different value for the estimate of probability which is in broad agreement with the other two participants.

The utilities assigned by the different participants are also similar. The only conspicuous difference seems to be between Jane and the other two participants for the utility of U5. This was valued at 30 whereas the other two participants valued this outcome at 0. When questioned about this, the participant stated that she felt that this high utility value had been assigned because at this point she may well have been looking at the decision from a departmental management perspective rather than a patient one. This difference in utility had an effect on the EU for not telling the patient for this participant. The effect was however not of a measure to produce a larger EU for not telling the patient than for telling her.

6.6 Evaluation of this stage of the research

These interviews demonstrated that decision analysis could be introduced to interviewees in a relatively short period of time. The explanation of the decision analysis process was short but in all cases the participants demonstrated that they understood the process by their ability to take part in the process. It became evident during these interviews that the process of decision analysis focused the interview and gave the participants a focal point on which to reflect. It is concluded from this that decision analysis can be used as a research tool to focus and obtain data from research interviews.

By providing participants with a decision tree structure they are confined to that structure. This is useful because it focuses the research interviews but it does confine the collection of data to the area pre-determined by the researcher of the decision tree structure. To get a fuller picture of the judgement and decision making process it would be better to give the participant the freedom to draw their own decision tree.

This stage of the research provided some insights into how those who are influential in setting policy and educating sonographers make decisions. They consider the decision that they are making from a number of perspectives. The perspective, which is most often articulated by them, is that of the patient. The three people interviewed found it impossible to undertake the decision analysis from their “organisational role” perspective.

6.7 The relationship between interviews with influential people and following stages of the research

The process of undertaking the decision analysis interviews with the three participants and the results that were obtained defined the direction of the research that followed. This stage demonstrated that decision analysis could be used as a research tool and hence it was used for the stages of the research that followed. This part of the research also demonstrated that the decision that sonographers make regarding the breaking of bad news could form the basis of the research that was to follow.

To allow further investigation decision making in ultrasound it was decided to use the same decision scenario with some modifications but to use an unstructured approach. This would allow the participants to structure their own decision trees and add values for probabilities and utilities.

Chapter 7

The in-depth interview sessions - method

7.0 Introduction

This chapter describes the interviews that were undertaken using decision analysis. The purpose of the interviews was to address the primary research questions:

- 1) What is the scope and nature of clinical judgements and decisions in radiography?
- 2) How are these judgements and decisions made in radiography?
- 3) What is the relationship between judgements and decisions made in radiography
- 4) Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?

These research questions give the study two major aims: **firstly** to gain a greater understanding of decision making and judgement in radiographic/sonographic practice and **secondly** to establish if decision analysis could be used as a research tool. The long interview sessions build on the research that had already taken place earlier in the study. The scope of radiographic decision making had been discovered during the observational stage of the research and a classification already established (see chapter 4). The observational stage also cast some light on the nature of radiographic judgement and decision making which was further explored during the interviews with the influential people. The long interview sessions allowed the nature of the decision making to be examined in much more detail. It was found that decision analysis made

the nature of decision making and judgement more transparent. During these sessions a greater understanding of how radiographers make decisions and judgements was gained. This is discussed in chapter 9. By using decision analysis, the participants not only gave detailed descriptions of how they were undertaking the decision analysis task, they also related this to their clinical decision making and judgement behaviours.

The other major aim of the study, to investigate the feasibility of using decision analysis as a research tool, was also tested in the long interviews. Decision analysis was used to a limited extent in the interviews with the influential people (see chapter 6). In the long interviews decision analysis was used in a different manner. During the influential people interviews the participants were given a tree and were simply required to add probabilities and utilities. In the long interview sessions being discussed here the participants were required to structure the tree as well as provide probability and utility values.

This chapter describes how decision analysis was used during the interview sessions. The interview sessions were conducted in two rounds. During the first round participants were given a scenario and were completely free to structure the decision tree how they saw fit. They were then required to add probability and utility values to the tree they had structured. During the second round of interviews the participants were asked to structure a decision tree based on a judgement that they had to make of an ultrasound image. A pilot interview was also undertaken before the participants were interviewed. The subject of this pilot interview was the same sonography educator who was interviewed as an “influential person” in Chapter 5. The results of this piloting are

presented and reflections made on the process. The problems encountered during the pilot are reviewed and the decision to use a computer program explained. Descriptions of the six participants interviewed (post pilot) are presented along with the criteria used to select these participants. The method adopted is described. The results from these interviews are presented in chapters 8,9,10 and 11.

7.1 Selection of participants

Interviews involved six participants, five of whom were sonographers and one was a patient. These interviews were conducted in two rounds. In the first round three sonographers and the patient was interviewed and in the second round two sonographers were interviewed.

No pretence is made that the data produced by these interviews can generate statistically based generalisations. However, the six interviews produced a wide range of data to analyse and evaluate. The decision to interview a small number of participants in depth is in keeping with the qualitative tradition of research. Beanland *et al* (1998) suggests:

“Generally, the number of participants, when using the qualitative approach, is smaller than the number of participants needed when using quantitative approach. Fewer participants are intensively studied (qualitative) as compared with a larger number extensively studied (quantitative).”

(pp241)

Experienced active (those undertaking sonography at the time of the study) sonographers were chosen for the study. By having these selection criteria it was hoped that the

participants would have encountered situations similar to the decision making scenario that was presented in the interviews. Within this criteria the participants were chosen to produce the widest possible variance in work experience. For this reason a sonography manager, a senior sonographer and a sonographer working in the community were chosen. A patient who had experience similar to the patient in the given scenario was also included. All of the participants in this part of the research came from the North West of England. Since the personal details are of relevance to what happened in the sessions brief details of the participants follows. For reasons of confidentiality the participants' names have been changed.

Participants interviewed in the 1st round of interviews.

Carol (Patient)

Carol is a 26-year-old secretary. Prior to the interview she had two pregnancies the second one concluding in a normal baby boy who was five months old at the time of the session. Her first pregnancy was ectopic. This is a condition where the embryo implants in the uterine tube rather than in the uterus. It is a painful acute condition that requires immediate emergency treatment. This pregnancy ended with emergency surgery to remove one of Carol's uterine tubes and end the pregnancy. At the time of the interview Carol had a negative perception of the medical advice that she received during her pregnancy. She reported that her GP had mis-diagnosed her condition during her first pregnancy. After the termination, hospital staff told her that she should have been referred to the general hospital at the start of her pregnancy. The GP had not made this referral but had prescribed bed rest instead. After a very traumatic period she was sent to hospital for ultrasound examination.

Carol's opinion of her treatment during the ultrasound scan was also negative. She had sensed that the sonographer had seen a major problem from the start of the examination, but the sonographer had not given her any information. The examination concluded with the sonographer telling Carol that she had seen a problem and that Carol needed to wait in the waiting room while the GP was informed. At this stage Carol was very distressed. On reflection the experience of being asked to stand in a crowded waiting room in a distressed state had been the low point of a very negative process. It became evident during the interview session that this experience had a great impact on the way she undertook the decision analysis process.

During her second pregnancy Carol had three ultrasound scans. The increased number of scans during this pregnancy resulted from her experience during the first. The scans took place in the same hospital department as before but Carol was not scanned by the first sonographer during the second pregnancy. During the second pregnancy two different sonographers scanned her. Her perception of these later scans was much more positive, the main reason seeming to be the increased amount of communication between herself and the sonographers. Information had been freely given during the scans. Carol was particularly impressed that a sonographer had been willing to share information even when it had not been completely positive. To illustrate this, she gave the example of the sonographer telling her that she was not completely sure about the presence of a pregnancy. At the time of this scan Carol desperately wanted to be pregnant so she felt that this was a form of bad news. She felt that the approaches of the sonographers were completely different. It is of interest to note that all of the sonographers that Carol met

during the two pregnancies were working under the same departmental and national policies and guidelines.

Gail (Sonography Manager)

Gail is a 32-year-old sonographer, married with no children. Gail started her career as a radiographer and trained in the hospital in which she now works. After spending some years working as a general radiographer she decided to specialise in ultrasound. She undertook a Diploma in Medical Ultrasound (DMU) course that she passed. Gail specialised in obstetric ultrasound and has become very experienced in this field. At the time of the interview Gail was the manager of the ultrasound department in a busy general hospital. A number of other sonographers are responsible to Gail.

Penny (Community Sonographer)

Penny trained as a radiographer and later specialised in ultrasound. Penny is married and has two children. She passed and was awarded the DMU by the College of Radiographers. For a number of years she worked in a general hospital undertaking all types of scans. During her time working in that hospital she had gained much obstetric ultrasound experience.

After working in the hospital environment for some years she decided to work in the community. Penny started her own company which provides a scanning service to GPs. Very few sonographers operate in this way, particularly in the location in which she operates. There has been a certain amount of friction between Penny and hospital consultants working in the locality. At the time of the interview Penny had been running

her company for about a year and it was becoming successful. She undertakes all the scanning herself.

Kate (Senior sonographer)

Kate is married and has four children of her own. Like the other two sonographers Kate started her professional life as a radiographer. Later she specialised in ultrasound by taking and passing the DMU from the College of Radiographers. She has become experienced in the field of obstetric ultrasound. This is the field in which she now undertakes most of her practice. Kate now works part time in a busy general hospital.

Participants interviewed in the 2nd round of interviews.

Susan (senior radiographer)

At the time of the interview Susan was a senior radiographer in a busy general hospital in the North West of England. She qualified as a sonographer by gaining a Diploma in Medical Ultrasound approximately 10 years prior to the research interview. Susan is very experienced in obstetric ultrasound and at the beginning of the interview reported that she had much experience of breaking bad news to patients regarding the condition of their foetus. Susan is married, but has no children. She reported that she had been “trying” for a family for a number of years. At the time of the research Susan was undergoing IVF treatments and as a consequence had had many ultrasound scans herself.

Hannah (manager)

Hannah is another experienced sonographer qualified with a Diploma in Medical Ultrasound. Hannah was married and had two children. At the time of the interview she

was the manager of a busy ultrasound department. Hannah had some familiarity with decision analysis as a result of taking a management course two years previously.

7.2 The interview procedure

The interviews were undertaken in the tradition of phenomenological research as it was thought that the data produced by this type of interview would best answer the research questions that had been posed. Phenomenological interviews are qualitative in nature. Qualitative interviews set out to intensively study the participants (Beanland *et al* 1998), they are best seen as an interchange of ideas and views between two people - a construction site of knowledge (Kvale 1996). Beanland *et al* (1998) states that

“Interviewing is a qualitative data-gathering technique during which information is shared. This method of data collection permits an exploration of a person’s feelings, ideas attitudes and thoughts in the words of the individual and not the words of the researcher.”

(pp294)

It will be seen from the extracts of the interviews that are included in chapters 8 and 9 that the interviews followed the style suggested by Beanland *et al*. The participants were taught decision analysis and invited to share their experience of using this technique that was new to them. They were also invited to relate this to their clinical practice and discuss this with the author who interviewed all participants. The interview sessions began with an explanation of the research and the reasons for the interviews. The participants were assured that all their responses were in confidence and that their identities would not be revealed to any third parties or in any publications. They were also assured that the interviews did not represent any kind of a test and that there were

no “right and wrong answers”. The interviews were conducted in a private office without interruption, except for a break taken for lunch. The sessions lasted from between six and eight hours each.

7.2.1 Pilot of in-depth interview

A pilot interview was conducted. Decision analysis was used as an exploration tool. The following decision scenario was developed for the pilot. It concerned the breaking of bad news to a patient.

A sonographer is working in a busy department undertaking routine obstetric scans at 18 weeks. Half way through her morning list Mrs Jones attends for such a scan. She is 35 years old and has had one child before with out any problems. The policy in the department is not to allow partners into the scan room and hence Mrs Jones has come for the scan on her own.

Soon the sonographer diagnoses a case of anencephaly. This is a condition that means that the baby will be stillborn or only survive a few hours.

What should the sonographer do in terms of giving information to the patient?

The ultrasound educator was first asked to comment on the realism of the scenario. He reported that he felt it was realistic and the interview continued. He had already been exposed to decision analysis during the “influential people” interviews earlier in the study. The participant was given a brief summary of decision analysis using a simple example. This method is discussed in detail chapter 8. He was then asked to draw a decision tree for the given scenario from the perspective of the sonographer in the scenario. Once the tree had been drawn he was asked to add probability and utility values where appropriate. It soon became apparent that the subject used a non-linear method of tree construction. Trees were drawn, redrawn and abandoned. There was a

high degree of back tracking and reflection. The difficulty of using a paper method to allow the subject to structure the decision quickly became apparent. The decision trees drawn by the participant soon became large, and when changes had to be made to nodes the whole tree had to be re-drawn. This became very time consuming. The calculation of expected utility was also time consuming. The time taken to undertake the process became a distraction for the participant. A decision tree was finally produced but a more elaborate method was clearly needed to produce decision trees during interviews.

After reflection the author decided to use a computer based program for decision analysis, hoping this would allow the subject more freedom when structuring their decision trees with much less loss of time. Rascati (1998) notes that "Health care decisions are apt to be complex, with branches and some probabilities that are difficult to estimate. Fortunately, computer software is available to aid with decision analysis" (pp35). The computerised method also had the advantage that different stages of tree production could be saved and investigated. A number of different software packages were reviewed, these included Microsoft Excel and Softtree. Although spreadsheet programs such as Excel are readily available they are not always formatted to show the flow of calculations (Ward *et al* 1997) and they did not seem graphical enough for teaching purposes. The computer programme eventually chosen was Decision Analysis by TreeAge (DATA). It was selected because it was Windows based and had excellent graphics. Participants could clearly see how their decision analysis was progressing on the computer screen. The program was run on a PC with large monitor so the participant could view the largest portion of the tree possible.

The ultrasound educator was re-interviewed using the software and it was established that many of the earlier practical problems had been overcome. The tree that was produced is shown in Appendix 2 as Tree 1 and Tree 2. Tree 2 is in fact the sub-tree that appears at the end of branches that end with “refer to clinic”. It was drawn separately because the tree had become complex.

7.2.2 First round of interviews

The method of introducing decision analysis to participants is an important issue. For this reason a separate section on this topic is included as chapter 8. Briefly the process of decision analysis was explained and the concepts of probability, utility and expected utility introduced using a simple example that is outlined in chapter 8. Participants were given the decision making scenario considered in section 7.2.1.

The computer and software (DATA) was explained, and participants were asked to structure their own decision tree for the scenario and add probabilities and utilities. This task was undertaken at a computer terminal with the participants instructing the researcher how they wanted the decision structured. They were then asked to provide probabilities and utility values. On the completion of each stage they were asked to reflect on their activity. All intermediate and final decision trees were saved to hard disk.

7.2.3 Second round of interviews

As with the long 1st round of interviews participants were introduced to the concept of decision analysis using the road-crossing example, which is explained in chapter 8.

At this stage the subject was encouraged to re-explore the judgement element of the scenario. The subjects were prompted to consider different levels of certainty for the judgement that they had made at the beginning of the process. The researcher then established how this judgmental certainty mapped onto the decision making aspect of the exercise and hence how it affected the decision. The issue of “base rates” was then explored. The subjects’ perception of the base rate for the condition was found by questioning (in the analysis after the interview this perceived base rate was compared with the empirical base rate found from the literature).

7.2.4 The scenario

A different scenario was developed for this part of the research. This scenario was developed after reflection on the previous phase of the study and the findings from them. In the first round of interviews participants felt, because of the nature of the abnormality, there was little if any chance of them making an incorrect diagnosis. The scenario used for the second round of interviews was therefore equivocal and forced the participants to make a judgement about the abnormality they were presented. This allowed the second round of interviews to investigate how the practitioner used these judgements to make decisions.

The scenario given to the participants in this set of sessions was as follows:

During a routine 18 week scan you obtain the following image of the foetal heart. This is the only information (view) that you can obtain. You must make a judgement about the foetus that is demonstrated in this image. Estimate the chance that this image demonstrates an abnormality.

In your department you routinely give information to patients regarding the presence or not of abnormalities seen. What do you tell the patient in this case?

The image referred to in the scenario is shown in Image 1 of a foetal heart was obtained and printed out on dye sublimation paper. This image was chosen because experts in the field have stated that the image looks abnormal even though the gold standard (a radiologist's report) report on the image was "no abnormality present". It was accordingly thought that this image would provide the subjects with a diagnostic challenge.

During the previous interviews the subjects had been first introduced to decision analysis and then given freedom to model a decision tree pertaining to an ultrasonic scenario. In the second round of interviews the author developed a decision tree for the scenario. This is the shown in Figure 20.

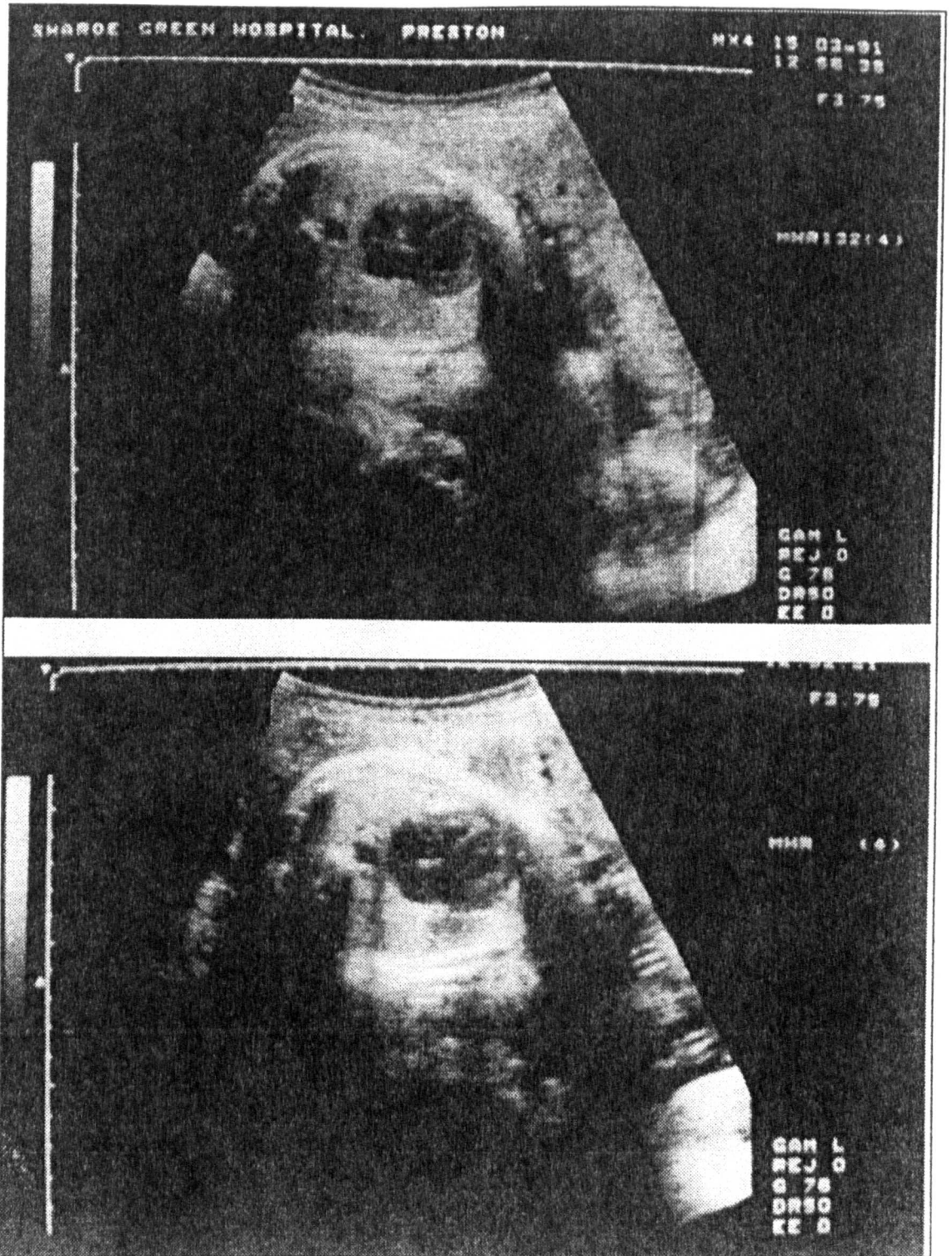


Image 1. Ultrasound Image used in second round of in-depth interviews.

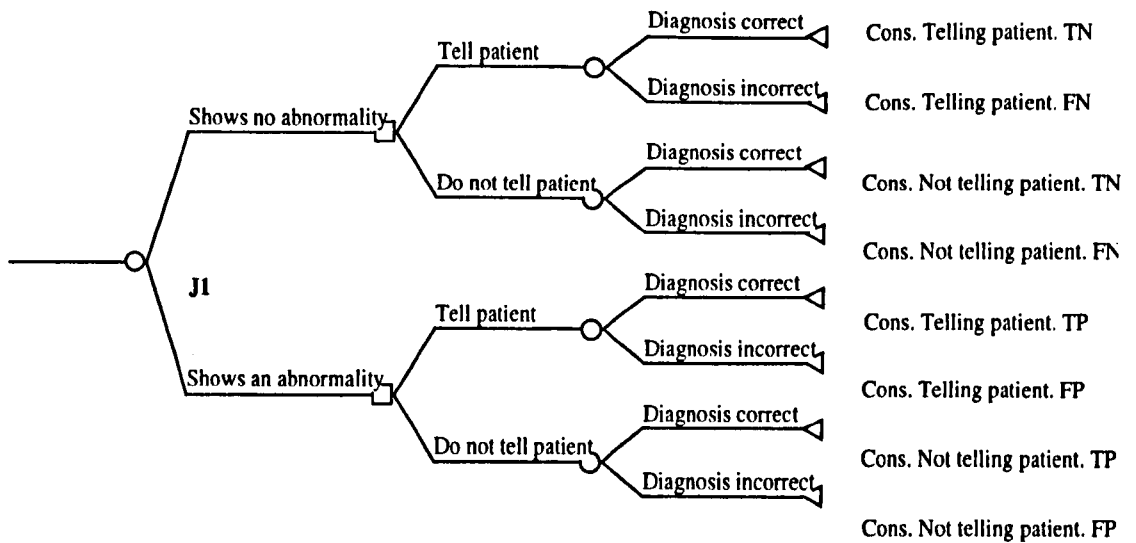


Figure 20 Decision tree developed for structured interviews

The tree shown in Figure 20 was based on the experience and knowledge gained in the previous stages of the research. It should be noted that J1 is a judgement node rather than a decision node. Both the new scenario and the tree modelled by the author were refined after discussion with the ultrasound educator consulted earlier in the project. During the final interviews the author's tree was not made available to the subjects. He used the tree as a basis for prompting subjects in drawing up their own. It will be seen from the decision trees in Appendix 7 and 8 that the structure of the decision trees is much simpler than that of those produced in the unstructured interviews.

Once the subjects had completed drawing their decision trees and adding probability and utility data expected utility values were calculated. At that stage of the interview participants were encouraged to re-explore the judgement element of the scenario. The

subjects were prompted to consider different levels of certainty for the judgement that they had made at the beginning of the process. The researcher then established how this judgmental certainty mapped onto the decision making aspect of the exercise and hence how it affected the decision. The issue of “base rates” was then explored. The subjects perception of the base rate for the condition was found by questioning (In the analysis after the interview this perceived base rate was compared with the empirical base rate found from the literature).

7.2.5 Data recording

Carol (the patient) and Gail (the sonography manager) were interviewed first, their interviews were recorded by the researcher making notes as the interview progressed. The interview notes and other details of the interview were written-up on the same day that the interview took place, so that the loss of detail was kept to a minimum. Extracts from these notes are included later in this chapter.

It became apparent during the first two interviews however that the interaction between the interviewer and the subject was very important. It was difficult to capture these interactions precisely using notes. In the next two interviews with Penny and Kate video and audiotape recording was used. These recordings were reviewed to establish important aspects and interactions. The interviews were analysed using references to the videotapes, transcriptions of the audiotapes, decision trees recorded during the interviews and notes taken during the first two interviews. A full discussion of the data recording methods used in this part of the research has appeared in chapter 3.

7.2.6 Data Analysis

As with the observational study these interviews produced a vast amount of qualitative data in the form of field notes and interview transcripts. Patton (1998) describes the analysis of qualitative data as a

“Painstaking process requiring long hours of careful work, going over notes, organising data, cross-validating data sources and finding, and marking linkages among the various parts of the data and emergent dimensions of the analysis.”
(pp297)

The author agrees with Patton and this was the experience of analysing the data from these interviews. The data was analysed in detail after each interview. This allowed gaps in the data to be identified and these to be addressed in later interviews. Lincoln and Guba’s (1985) method of qualitative data analysis was used. The first step was unitising the data. During this stage of the data analysis key units of information from the data was identified. In all cases this was in the form of a statement made by one of participants. The next step was categorising the data, grouping statements together into categories that were internally consistent. Bailey (1997) defines internally consistent as groups that do not overlap each other and include all relevant data. Lincoln and Guba (1985) describe the next stage of data analysis as “filling in patterns”. By this they mean collecting further data to flesh out the categories. This was done from one interview to the next. It was eventually decided that to fully address the fourth research question; “Can decision analysis be used to investigate the relationship between judgement and decision making?” another set of long interviews would have to take place, using a different interview structure.

Chapter 8

Decision analysis as a research tool

8.0 Introduction

A major aim of this study was to determine if decision analysis could be used as a research tool. The interviews with the “influential people” discussed in chapter 6 established that in the context of an interview, participants could provide chance and utility values for a provided decision tree. In the next stage of the study participants were asked to complete all stage of a decision analysis.

Decision analysis is used in this study as a tool to structure the research interviews. It is used to obtain information from participants. It is relatively unusual to use interviews that are focused around a theoretical technique when undertaking phenomenological research. However in this study the decision analysis is used in these interviews to elicit in-depth information from the participants about their experiences and perceptions of judgement and decision making. It is argued that the decision analysis enhances this phenomenological study.

Chapter 2 reviewed how decision analysis had been used by a number of health care professions as a clinical decision aid. With the development of “evidence based practice” there is a growing awareness that practice must be based on research and evidence to ensure that clinical practice has proven effectiveness (Evidence -based Medicine Working Group 1992, Davidoff *et al* 1995, Rosenberg 1995, Dowie 1996a)

describes a research practice gap, which leads to “*even methodologically sound findings that have clear implications for practice and patients, are reflected belatedly, and sometimes not at all, in the behaviour of many health care professionals*”. He goes on to assert that decision analysis can be used to implement research findings. Dowie (1996b) argues that decision analysis is the best form of systems aided approach to bridge the research-practice gap. Lilford *et al* (1998) also demonstrates how decision analysis can be utilised in the implementation of research findings.

Dowie (1996b) puts forward a radical argument that there needs to be a paradigm shift within medicine that entails the introduction of “*decision analysis based medical decision making DABMDM*”. He argues strongly that the medical profession cannot move towards the introduction of evidence based and cost effective and preference based medical practice until DABMDM is adopted. In this paper Dowie thus moves on from proposing that decision analysis should be used to address the research-practice gap to a proposal that decision analysis becomes the basis for all medical practice.

Considering the widespread use of decision analysis as a decision aid and the growing importance of decision analysis as a method for introducing evidence based practice it is surprising that there is not more interest in decision analysis as a research tool. Clemen (1996) claims that decision analysis can be used to “gain insight” this would indicate that decision analysis could be a valuable research tool. In the research used for this study extensive use was made of decision analysis as a research tool. The remainder of this chapter discusses how decision analysis was introduced to participants and reviews their experience of undertaking a decision analysis as part of a research interview.

8.1 Introducing the participants to decision analysis

If decision analysis is to be used as a research tool to structure interviews it is essential that the technique can be introduced to participants relatively quickly. If a technique takes too long to introduce, it would not be possible to use it within the time constraints of an interview. During the interviews, participants were introduced to decision analysis and asked to undertake a decision analysis within the space of one day. Participants had never encountered decision analysis before, these sessions therefore provided information regarding how decision analysis can be quickly introduced and taught to people. This is an area that is not well discussed in the literature. Detsky *et al* (1997), Naglie *et al* (1997), Krahn *et al* (1997), Naimark *et al* (1997) and Redelmeier *et al* (1997) describe how decision analysis can be introduced to medical students, over the period of a semester (six months). These authors give valuable advice on how decision analysis can be introduced but the time scale they use to teach decision analysis would be impractical within a research context. Others (Rascati 1998, Keeney and Raiffa 1976, Weinstein and Fineburg 1980, French 1989, Sox *et al* 1988) who have given accounts of the introduction of decision analysis have not reported the time scale used for its introduction. It is therefore important to establish the best methods to introduce professionals to decision analysis if the research benefits are to be achieved.

The principles used to introduce participants to decision analysis were based on the work of Kolb (1984) and Sowe (1995). The relationship of the work of Kolb and Sowe to the methods used in this study is discussed later in this section. Participants were

introduced to the basics of decision analysis by working through a simple example on a white board. The example was a simple scenario regarding "crossing the road while on the way to a job interview". This was:

"You are on the way to a job interview and you are just in time. You have to cross a busy road. If you cross at once you will be on time, if you wait for a stream of traffic which is 100 meters away to pass you will be late for the interview. Do you cross or not?"

The decision tree drawn for this decision is shown in Figure 9.

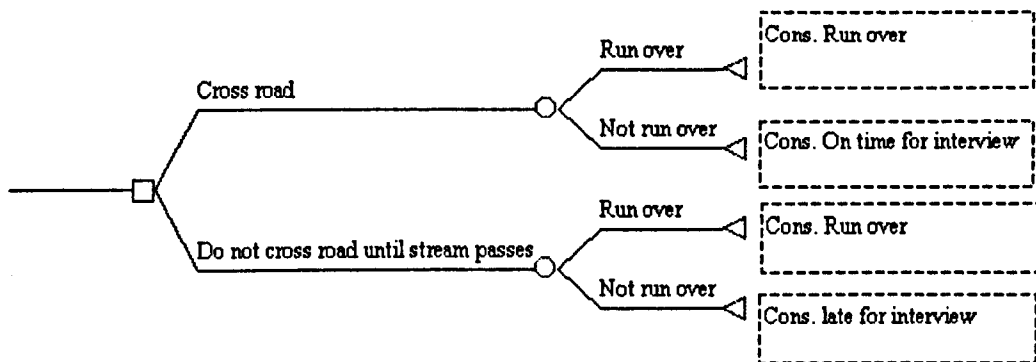


Figure 9 The road crossing decision tree used to teach decision analysis

This example was chosen because it was a scenario that the participants would be familiar with. To complete the decision analysis for this scenario the decision maker has to value health states in terms of estimating a utility for "being run over". It was hoped that this simple introduction to valuing health states would help participants to undertake a similar task as part of their own ultrasound decision analysis. Participants were told that the consequence of being run over in this simple example was death.

The road-crossing example was demonstrated to the participants interspersed with the work they were undertaking on their sonographic decision analysis. Hence, participants were shown how the crossing the road decision could be structured and were then asked to structure their own sonographic decision. Once they had completed this task they were shown how probability values could be added to the crossing the road tree and then asked to do this for their own tree. This technique was also used for the utilities and expected utilities. The following extract is from the transcript of the interview with Kate. It is included to illustrate how the road-crossing example was used to introduce decision analysis to the participants. This section of the transcript is from the point where Kate is being introduced to the concept of assigning probabilities to the decision tree:

Researcher: The next step of decision analysis is to go back to the simple crossing the road decision. The next thing that we can try and do on this is to bring in chance. Actually try and decide what the chance is in the situation, and try and model that, because we live in a pretty uncertain world and we never know what is going to happen. A decision analysis, hopefully, helps us to deal with it. So what we do is consider the chances of things happening in this situation, If we cross the road, what is the chance of getting run over?

Kate: I suppose it depends on where the vehicle is.

Researcher: 100 meters. So what's the chance.

Kate: How fast you can run?

Researcher: How fast you can run! And you always tell your kids not to run!

Kate: *I don't tell them to run, no, they have to wait until it is all clear.*

Researcher: *Well let's just say that in this situation there is an 80% chance that we are not going to get run over. So the chance that we would get run over is?*

Kate: *20%?*

Researcher: *Yes. So you would put 0.2. So that is a probability. 0.2 is just the same as saying 20%. The Computer likes 0.2 better. The probability of getting run over is 0.2. The chance of not getting run over is 0.8 because of course the two probabilities have to add up to 1. Because something has got to happen, so it has to be 1. 1 is certainty.*

Kate *Right.*

Researcher: *If we don't cross the road, what is the chance that we still get run over?*

Kate: *Right, well if you didn't cross the road how would you get run over?*

Researcher: *Well I guess there is always the chance that the car could mount the kerb and hit you.*

Kate: *I guess so. I don't know a million to one.*

Researcher: *Well that's an "odds". I don't want to get into that – but a million to one is about 0.0001% chance. Does that sound right a 0.0001% chance?*

Kate: *I don't know. It's just a guess. Yes put that in.*

Researcher: *You're right it is a guess or an estimate – but it is based on your experience of crossing the road. In other words it's based on your observations. When you think about it that's what all chance measurements are based on – observations.*

Even chances quoted in research papers are based on observation.

Kate: *I guess so.*

Researcher: *So if there is a 0.0001% chance of getting run over when you do not cross there must be a 0.9999 chance that you will not get run over if you don't cross.*

Kate: *If you say so.*

Researcher: *Well look if 0.0001 and 0.9999 are added to together they add up to 1 – certainty.*

Kate: *Yes I can see that. It has to add up to 1 on this branch like it did for that one to cross the road.*

Researcher: *Now we have to add chance values to all the branches after each of your chance nodes.*

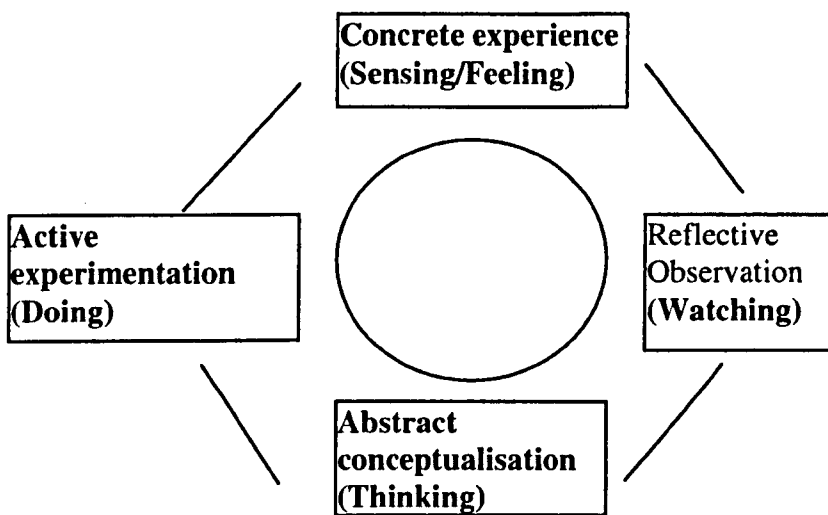
Sheer look of horror!! ha, ha

So, yes, so that is exactly what we have to do, we have to go back to decision tree 5, and we have got work through this and think about the various probabilities. Erm, maybe not as daunting as it might seem, because as you said before a lot of this decision tree is the same, so the probability should be the same, so if I can just fold this in half, I think it sometimes helps to have the paper copy because you have an overview. Let's see how we get on anyway.

It is evident from this simple interchange that Kate has understood the basics of chance as applied to a decision tree. Although no pretence is made that Kate has developed a deep understanding of chance and probability it is felt that she has enough understanding to be meaningfully guided through a decision analysis of her own. Kate went on to add

chance values to her own decision tree before being taught about utilities using the road-crossing example. This method was used for all interviews.

Decision analysis was introduced to the participants in the style of active learning or learning by doing using a simple example (road crossing). They were then invited to apply the techniques learnt to their own decision tree. This could be considered to be cognisant with Kolb's (1984) cycle of learning shown in Figure. 16.



Taken from Kolb 1984

Figure. 16 Kolb learning cycle

The participants' involvement in the road-crossing decision analysis can be considered to be the Reflective Observation (Watching) and partly the Abstract Conceptualisation. During this part of the introduction each participant was shown how to structure and add probability and utility values to the decision tree. Although the participant was having an input to these activities the dominant activity was watching and thinking. In the extract from Kate's interview given above it can be seen that in the first instance the value for the chance of not being hit by the car was given – 80%. Kate was asked to provide the

value the next time this situation was encountered i.e. the value for being hit by a car even if the road was not crossed. When participants were asked to add values they were becoming involved to a limited extent in Active Experimentation (Doing). When the participant came to draw their own decision tree they went through the Active experimentation (Doing) and Concrete Experience (Sensing /Feeling) parts of Kolbs's learning cycle.

Sowey (1995) suggests the two most important factors that make teaching memorable are the structure and "worthwhileness" of the teaching. These two factors would also seem to be equally important in considering the effectiveness of a small scale teaching program such as introducing participants to decision analysis.

In terms of structure Sowey considers coherence and perspective. The manner in which the participants were introduced to decision analysis did have coherence. The method flowed well and was well integrated into the participants own decision analysis. The manner in which the road-crossing example was used and the way students undertook their own example put the technique into perspective.

In terms of "worthwhileness", Sowey considers intellectual excitement, resilience to challenging questioning and practical usefulness. The process of decision analysis proved intrinsically intellectually exciting. All participants saw the value of the technique and seemed to be excited by the prospect of undertaking their own decision trees. A typical response to decision analysis is seen in an extract from the interview with Susan:

Susan: I am enjoying this because I have never reflected on my thoughts and my actions and my decisions.

Researcher: I think a lot of people do

While introducing decision analysis the participants had many questions. The researcher answered all these to the best of his ability and it is felt that the teaching did stand up to questioning by participants. Finally, by requiring students to undertake their own decision analysis from their own clinical experience the participants could see the practical usefulness of the technique.

During the course of the interviews it was found that simple decision analysis could be taught relatively quickly using the method described. Although participants may not have achieved an in depth understanding of decision analysis they had learnt enough to be able, with assistance, to produce a decision tree and produce useful research data. From the experience of undertaking these interviews using decision analysis it is concluded that decision analysis is a useful research tool.

8.2 Undertaking decision analysis

This section reviews the participants' experience of undertaking a decision. The section is organised into sub-sections covering; structuring trees, adding probabilities, adding utilities and calculating expected utility. However, although these headings are useful in structuring this section it will be seen that the processes that the participants actually followed do not fit neatly under them.

8.2.1 Structuring of decision trees

One of the most notable features of the sessions was the manner in which participants structured their decision trees. In the literature there are very few reports of how people go about the process of decision analysis. The underlying assumption is that decision analysis follows the normative four stage process with the structuring of tree, assigning probabilities, assigning utilities, and calculation of expected utility being undertaken consecutively. Pauker and Pauker (1986) describe this type of linear progression. In their account of decision analysis they clearly indicate that decision analysis progresses in a stepped fashion. They state that “*the first step is to structure the problem*” (pp154) they go on to state “*the next step in the analysis is to assign relative values*” (pp155). From the observations of the decision analytic process made during the interviews however, it seems that the relationship between the various stages is non-linear and participants often skipped backwards and forwards between the first three stages of the analysis. The process of decision analysis observed in this study is much closer to the description given by Phillips (in Dowie 1992):

“Doing a decision analysis is always an interactive process: you go back and change bits you’ve already done as you get clearer about the problem. Probabilities and utilities are not residing in the head ready to be plucked out, they emerge and are formed during the modelling; they are more generated than assessed.”

This non-linear progression of structuring can be confirmed in extracts from the reports written up from notes made during the sessions with Gail and Carol.

Extract from the report of Carol's session (the trees C1 – C8 are reproduced in

Appendix 3):

At this stage Carol considered the structure of her decision tree. One of the first points made by Carol was that there is a chance that the sonographer could get the diagnosis wrong and she felt it important that this aspect be considered in the structure of the tree. After some consideration she came up with five possible courses of action that the sonographer could take:

- a) to give no information and refer to GP (this reflects what had happened to her during her first pregnancy)*
- b) to say nothing and go through the normal process*
- c) to discuss the problem with the patient and allow them to ask further questions*
- d) to tell the patient everything*
- e) to refer the patient to the outpatients clinic without giving any information.*

During the process of structuring the tree Carol was making continual references to her own experiences of ultrasound. The structure of her tree is very much based on experience.

At this point tree C1 was drawn.

Carol next considered the "abnormality not present" branch. She felt that in this case the opinions of the sonographer would have been taken at face value and the process would simply continue in the normal manner. If this was a normal pregnancy this would be fine if the diagnosis was correct (TN) and only a problem if the sonographer thought there was no abnormality when in fact there was (FN).

At this stage C2 was drawn

Carol felt that there must be many reactions to hearing that the pregnancy was in such a dire state. She decided to simplify these down to two possible outcomes - hysterical and calm. She felt that she was not making any value judgements in using these terms. She stated that she had remained calm during her first ultrasound scan but she did not feel that she could have been any more upset or

distressed if she had been hysterical. These possible occurrences were put into the structure of the tree.

At this stage C3 was drawn.

The care of the patient after the news was given was then considered. Again Carol's own treatment had a large bearing on structuring of this part of the tree. Carol thought that the patient could either be put into a private place with some support to think over the situation or she could be put into the public waiting room. Carol thought that this was a conscious decision that the sonographer has to make and she stated that she felt it should be well thought out rather than being left to chance occurrence.

At this stage C4 was drawn.

Carol felt that this part of the tree could be repeated for the false positive branch because if this was the case neither the radiographer or the patient would be aware that there had been a mis-diagnosis, and hence the interaction between sonographer and patient would remain unchanged. This was an important point in the introduction to decision analysis hence it demonstrated that Carol had begun to appreciate the differences between judgements and decisions but was still some way off understanding this.

At this stage C5 was drawn.

The insight that had been gained in structuring C5 prompted Carol to reflect on the first decision node. This was the aspect of the decision analysis that the researcher had been most concerned about during the session. Carol could see that the branches coming off this node did not represent a decision but more a judgement that was being made by the sonographer in relation to the images she was seeing during the scan. The problem of the first node was considered in some depth. The action to be taken in relation to this node was left to Carol. After reflection Carol decided that the accuracy of the sonographers diagnosis would not change the decisions made regarding the information to give the patient. The issue of accuracy of diagnosis only became a problem later in the pregnancy. At this stage Carol felt happy about the structure of the tree and felt that it reflected the decision

making process that takes place i.e. it was descriptively accurate.

At this stage C6 was drawn.

Carol's Reflections on the structuring process.

At this point Carol was asked to reflect on the process of structuring she had engaged in. Her first reflection on the process was that it added complexity to an otherwise simple decision, or in her words "turns a simple decision into a complicated one". She stated that the exercise was time consuming when the decision being made seemed quite straight forward and in her opinion there was a proper action to be taken in this case- the patient should always be given full information.

She did, however, feel that the process of structuring the decision had prompted her to think about it in detail and she had found this process enlightening. By considering each stage of the decision she had been able to reflect in detail on the process that she had been party to. It was very evident that Carol was displaying great empathy with the scenario patient, to the extent that the researcher felt at times Carol was substituting herself for the patient in the scenario.

She felt that if sonographers were required to go through this process they might well give more consideration to their patients. The main perceived benefit was that the sonographers would see that what they considered to be routine was in fact very important and new to the patient. She did however feel that the sonographer's personality had a massive impact on the patient/sonographer interaction.

This extract demonstrates that Carol goes through the process of structuring a decision tree and then reflects on it. As a result of this reflection she is prompted to re-structure the tree. It is also evident from this extract that there is a richness of information forthcoming which may not have been present if a standard interview procedure had been followed.

It can be seen that during the structuring phase of the decision analysis Carol drew six trees in all. In fact, C6 turned out not to be the end of the structuring process for Carol. Another two trees (C7 and C8) were drawn as a result of the probability/utility assigning. These are interesting trees because the adding of probability and utility values prompted change in the structure of the tree. In other words the process of considering probabilities and utilities made Carol reflect further on her structure and to change it twice.

The complexity of the structuring process was confirmed in the interview with Gail (the sonography manager). The following extract is from the report written following Gail's interview:

Gail stated very strongly at the start of the modelling that the decision was not simply whether to tell or not to tell - but what to tell the patient. A simple tree was begun, which included a number of alternative actions. She was happy with the alternatives but uncomfortable about the structure. After some reflection she came to the conclusion that the tree needed to reflect the importance of patient assessment by the sonographer. The initial tree was completely remodelled to include such assessment.

At this stage tree G1 was drawn. It can be seen that this concentrates mainly on the assessment of the patients' reaction to bad news and the chances of the sonographer making a wrong assessment of the patient.

At this stage Gail asked for more information about the clinical environment and the departmental policy. After discussion it was decided that Gail should use her own clinical situation as a reference point for modelling the decision. Once this was decided discussion took place about the chances of making the wrong assessment of the patient. Gail felt that most women attending for an ultrasound scan expect as well as hope for normality. This could make the process of assessment difficult and was

one of the reasons why information would not be given directly and immediately, but rather in stages, so assessment can be made and modified as the bad news was being given in her view. The information giving, patient assessment and evaluation became a blended process. Gail stated that this was one of the reasons that she was finding the process of modelling the decision difficult.

As a result of this decision Gail completely remodelled the tree. The new tree included the action of giving a limited explanation and then providing more detail as the outcome of the assessment and the patient's reaction to the bad news became known.

Gail said that all patients understood the simple explanation to some extent and she was happy to let the patient take the lead and ask the questions that they wanted. She thought that many patients would not want full information at this stage and it should be offered step by step. Although she did not want the patient to leave the examination with dis-information she did want the patient to leave with as little information as possible because it was not the sonographers role to give all the information that was needed by the patient.

This was a new aspect to the decision making process that had not been discussed before. In particular Gail had not mentioned any limitation of information when discussing policy.

After considering the points made above tree G2 was drawn.

It can be seen that the tree has been radically changed and the emphasis is now on patient understanding of the explanation that is given. In tree G1 the uncertainty involved the sonographers assessment of the patient. G2 is more patient centred with the main uncertainty being the extent to which the patient understands the explanation that they are given. G2 is also more complex because it incorporates a second level of uncertainty concerning the chances of the patient asking more questions or accepting the information produced as adequate.

Gail was happy with the new tree and said that if the patient accepted the situation they would be referred back to the clinic and "that would be the end of the story".

The researcher now prompted Gail to think about other possible alternatives after the chance nodes. She was asked if there were any other possible outcomes. After some reflection Gail said that there was a chance that the patient would deny the situation, break down and become very upset.

At this point Gail said that she wished that she had more knowledge about the task she was undertaking before attending the session. If this had been the case she would have made some notes before she had come. She recounted a recent case that had taken place in the department. In this case the patient had felt there was a problem with the pregnancy and had taken the bad news in her stride. The sonographer felt that the bad news had almost been a relief in removing the uncertainty. However Gail reported that the partner in this case had been very upset and had been the one who needed support.

What was becoming evident to the researcher by this stage of the interview was that the trees that were being drawn had no real decision nodes. Although the label "What to tell" was followed by a choice node it was discrete in that Gail really only allowed one option for the amount of information and the type of information that was given. The tree seemed to reflect a practitioner working to a policy under conditions of uncertainty.

Gail now gave more thought to the patient's reaction to the news that they were being given. She now kept coming back to the point that the most stressful thing for the patient would be to give them no information at all. She thought by giving information in stages the patient would not become upset early in the process. Only later, after questions were answered progressively, would this happen. She now felt that there was one other possible outcome to the giving of unexpected bad news and this was shock.

At this stage Gail was asked to think about her responses to each of the possible events. She said that if the patient became upset then she would comfort the patient and offer an immediate referral to the clinic. (It was in her power to

send patients to the referring clinic when she thought that it was necessary) Often in cases like the one in the scenario she would allow the patient to be alone for a few minutes. If the patient was in shock then she would ask a mid-wife to attend and escort the patient back to the clinic.

G3 was now drawn. The move from G2 to G3 was a progression not a radical re-draw with only further levels of chance being modelled.

Gail seemed happy with the structure of the tree incorporating the referral possibilities. She was asked to reflect on the process of developing the tree.

Gail's reflections on structuring the decision tree

Gail said she had found this a difficult task but once she had managed to put on two branches she felt much more confident. She thought it was a very logical process, but was worried that some of the possible options had not been incorporated into the tree. This reflection prompted Gail to take another look at her tree and she quickly decided she wanted to change it. She produced G4. This was a lot more complex because it included a third possible response by the patient and new possible courses of action to be followed by the sonographer.

At this point the researcher's concern that there did not seem to be a decision included on the tree was raised with Gail. Each decision node included only one option and the tree seemed more like an algorithm or flow chart than a decision tree. After some discussion it was decided that the problem was at the origin of the tree. In fact a decision was being made here - to give the patient information or not, but this had not yet been modelled on the tree. After consideration of this G5 was drawn.

Gail considered the tree at some length and was again happy with the structure. She made the point that in practice she would always give some information to the patient but now realised that this was a decision that she was making.

It is interesting to note that even though the decision tree had felt to have been finalised with the production of G4, the reflection process motivated a change in the structure

of the tree. It would seem from this that reflection is a vital aspect of structuring a decision tree.

There are similarities between these two extracts from the reports made on Gail's and Carol's interview. Both draw a number of trees before they are happy with the structure. Decision trees are drawn reflected on and then refined.

This radical re-structuring did not always take place during the structuring phase of the decision analysis. Facing up to the task of adding probabilities and utilities to the tree often had a major impact on the structuring process. On more than one occasion participants restructured the decision tree at a very advanced stage because the assigning of probabilities and utilities seemed to give them some insight into the structuring of the tree.

The impact of assigning probabilities on structure can be seen clearly in the session with the patient (Carol) between her trees C6 and C7. These are shown in detail in Appendix 3 and in condensed form below in Figure 17 and 18.

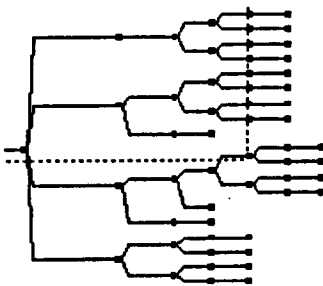


Figure 17 Tree C5

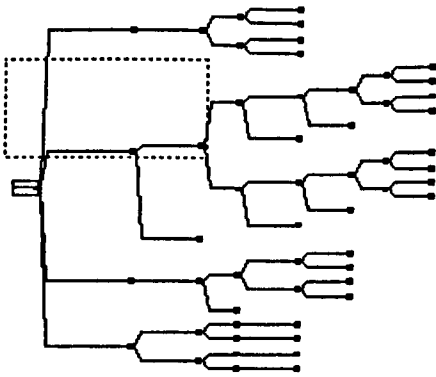


Figure. 18 Tree C6

The changes made to the structure between trees C6 and C7 took place during assigning of probabilities. The main difference between these two trees is that the second branch after the decision node has become more complex. This came about after Carol had considered the probabilities to this branch. In considering the probability values she became aware that the structure of the tree was not adequate to define her perception of the decision making scenario, hence, the structure was changed. It is clear from this that thinking about probabilities had a massive impact on the structure of the tree.

Structuring the decision tree is an important aspect of the decision analysis. From the evidence obtained during these interviews it was found that participants could structure their own decision trees after a relatively short introduction to the techniques using a simple example. Decisions were structured in a non-linear fashion with participants moving backwards and forwards between parts of the decision analysis process refining the structure of their trees.

8.2.2 Assigning probabilities

The next aspect of decision analysis to be considered is the adding of chance values - probabilities. A full discussion of this aspect of decision analysis and a review of the relevant literature can be found in sections 2.1.2 – 2.1.5. An extract from Kate's interview is included in section. 8.3 that illustrates how the assigning of probabilities was introduced to the participants. The following extract from the report written on Carol's interview demonstrates how she went about the process of adding chance values to the tree she had structured:

When tree C6 was completed the process of adding probabilities to the decision tree was explained using the road-crossing example. This was done using the white board. The nature of probabilities was briefly considered. Some time was taken to reflect on the fact that in this example we would choose to attempt to cross a road even when there was some potential for death. The researcher and Carol discussed the nature of an uncertain world and the fact that we would undertake no actions if we did not accept the risks involved. Carol seemed to understand the nature of uncertainty, probability and risk and was quite happy about how they related to the structuring of decisions during a decision analysis.

After this introduction Carol set about her task of adding probabilities to the tree. Almost at once she felt that there was a problem with the structure of the tree that the consideration of probabilities had brought to light. The tree was therefore restructured at this early stage. This was an important point in the decision analysis and it demonstrated the relationship between the assigning of probabilities and the structuring of the decision tree. The assigning of probabilities had not been undertaken in isolation from the overall structure of the tree.

C7 was drawn at this stage.

It was obvious that Carol found this part of the session increasingly difficult. She stated that she did not often think about chance and probability. What made this aspect of the decision analysis even harder was being asked to assign numbers to indicate her estimate of chance. It became evident in the session that she was first making an assessment using words and then converting this to a number. An expression such as "a very small chance" was converted into a number such as 3%.

Carol was concerned that she was trying to estimate the probabilities in relation to herself. She felt that she was assigning probabilities to the way she would react, rather than taking a global perspective and trying to estimate probabilities for all women. This concern would again seem to indicate that Carol identified very closely with the paper patient in the scenario. After some thought she decided that she must try to assign probabilities for all women but this would be done in relation to the way that she thought she would act in these situations. When Carol was questioned further on this matter she could not completely define what she meant by "all women" but it seemed she meant women of her own age and background who attended for ultrasound scans.

She also stated that in assigning the probabilities she was very tempted to simply assign a 50/50 chance for many of the events. In her own words she felt that she wanted to "cop out" of the situation. She did, however, identify this weakness and did not succumb to it.

The assigning of probability was very time consuming with each probability being considered in detail.

Some particularly interesting observations were made when Carol came to assign probabilities for patients asking questions. She said that the chance of patients asking questions was relatively low. In her opinion this was because people are very reluctant to ask questions of health care professionals. She felt that quite often much of the information gained by the patient came from non-verbal rather than verbal communication following from the patient asking questions. This is an interesting observation as it demonstrates how decision analysis can be used as a tool to investigate practitioner patient relationships.

Most of the probabilities that were assigned to the branches on the tree were re-visited on a number of occasions and most of the probabilities were changed on more than one occasion. It was common for the probabilities that had been assigned to be re-evaluated after other probabilities had been added to the tree elsewhere. Probabilities assigned were continually being compared to the others that had been assigned. There was no evidence that the probabilities were being assigned in isolation.

Carol persevered with the task and added probabilities to all chance nodes.

At this stage C8 was drawn.

Carol's Reflections on adding probabilities

On reflection Carol's greatest challenge had been to try and estimate probabilities for all women or even the specific woman in the scenario when she only had her own experience to rely on. She thought at one point "Who am I to be saying how other people will react". This may well be a factor that is common to patients rather than health care professionals. She felt that health care professionals would be much more willing to estimate the chance of various occurrences as this is part of their work.

Carol did not feel that the probabilities she had supplied were very accurate. She had found the process very difficult and felt that some of her values were "guesstimates" based on her own experience. This was a major concern for Carol and she was concerned that major decisions of this nature could be based on estimates of chance that were possibly very inaccurate. There seemed to be a distinct lack of confidence on her part during this part of the analysis, clearly related to Carol's limited experience in this field and patient status.

When asked if she felt that sonographers would be adding better probabilities she was not sure. She felt that they may be more accurate but was not happy about them estimating how others - patients would react. This concern again seems to be based on her own negative experience of ultrasound. In her opinion the problems that she encountered could now be seen to have their basis in the inaccurate judgements made by the sonographer. This was

an interesting reflection on Carol's part and it seemed that the process of decision analysis had helped her to understand what had happened during her own ultrasound scan.

It should be remembered that Carol is a patient rather than a health care professional. Her experience of ultrasound is confined to her own scans during two pregnancies. It is evident from this extract that Carol found the process of adding probability values a difficult one. Carol had not really given a lot of thought to the concept of chance before. It is also evident that the process being used is a dynamic one with values being added and then compared to other values already entered on the tree.

The next extract comes from the report written on the interview with Gail the manager of an ultrasound department. Unlike Carol, Gail has a great deal of experience of ultrasound and the scenario was familiar to Gail. This extract comes from the part of the report that covers Gail's attempt to add chance values to the tree she had structured.

The task of assigning probabilities was discussed with Gail using the road-crossing example. She stated that it would have been very helpful if she had more prior information so that she could have collected more information to make the probabilities more "objective", i.e. frequency based.

It is interesting that even at this early stage of Gail's introduction to decision analysis she was making the distinction between objective and subjective probabilities. Decision analysis seems to produce a desire for "objective" probabilities, which would often not be considered in clinical practice. This may indicate that decision analysis encourages a deeper, and more evidence based, approach to decision making.

Gail worked through the tree and assigned probabilities. The greatest problems in assigning probabilities occurred on the sub tree where no information was given at all. Gail felt this was because she would rarely if ever consider this option and she could not generate any frequencies even rough ones.

It is not surprising that this caused some difficulties because in assigning probabilities the practitioner can only go on experience. If, as in this case, that experience is very limited then the process of probability estimation is arduous.

It was obvious from observing Gail that each probability was not being estimated in isolation she was relating the chance assigned on one chance node to that on others. For example if she had assigned 30% to one branch this would be compared with other chances that were being considered, on other branches, not merely those coming off the same chance node.

After much work and thought the tree G7 was completed.

Reflections on assigning probabilities

On reflection Gail thought that the probabilities would have been very different if this had been a suspected case of Down's syndrome. With anencephaly the diagnosis was so easy to make that Gail had a problem accepting that there was any chance the diagnosis could be wrong. She felt that the probabilities for the tree would change for each condition that was being considered, and this revealed her developing understanding of the decision analytic approach.

Gail thought that the probabilities she had assigned were estimates based on her experience of the condition being considered. She did feel that she had grasped the concept of chance and that this had not caused her too many problems. This is not surprising considering her professional background, where prevalence of abnormality is considered routinely.

There are a number of interesting aspects to Gail's interview, which were commented on in the report written at the time of the interview. Like Carol, Gail had problems in

assigning values where she had little experience. On the whole sonographers seemed to identify a common population - the women that they routinely scanned to base their estimates of chance. Carol, on the other hand, had a tendency to give a value for the chance of herself reacting in a particular way. On questioning she felt that this would probably be a different compared to other patients.

From the extracts from the reports of Carol's and Gail's interviews there is an indication that there is a dynamic comparative approach taken to assigning values of chance. Different chance values on different branches of the tree are compared and evaluated, before a value is decided.

Gail classified chance values into objective and subjective values at the beginning of the interview. This was after the road-crossing example was introduced and the point was made that all chance values were by nature the same regardless of their origin (see section 8.3). There were indications that the sonographers felt that information acquired from the literature was "factual". Take for example the following extract from the interview with Hannah:

Researcher: What about that 90% number you just used? Would you use that?

Hannah: Well that's because that is a more factual figure. For a normal four chamber view they say that you're excluding you know I think it is 90 or 95 % of abnormalities. That's a more factual number that is from literature. Whereas any number that I could possibly give is just one out of the air.

Like Gail, Hannah not only indicates that the values that she estimates are of less value than those acquired from the literature, but also that by nature are different, i.e. data from the literature is “factual” and her estimates are “just out of the air”. It is interesting that even though Hannah feels that this is chance value is “factual” she does not know the it’s exact value, stating it is 90% or 95%. From this it could be deduced that in clinical practice Hannah does not use this value. When other sonographers were questioned regarding how much numerical data gained from the literature was used in their professional practice they stated that it was not used very often. One example that two of the sonographers came up with was the chance of a spontaneous abortion during an amniocentesis, which they gave as 1%. This probability was always given to patients before they embarked on such a test. Consideration of this is seen from the following extract from the transcript of Penny’s interview:

Researcher: Are there ever times when you use numbers in practice to base your decisions on or communicate with patients.

Penny: Not really. Well maybe when we do amnios – we tell them the chance of a spontaneous abortion.

Researcher: What do you tell the patient.

Penny: 1%

Researcher: So you tell them a 1% chance of an abortion?

Penny: Yes

Researcher: Where does this figure come from.

Penny: It’s one that we have always used. But it comes from research. Some places tell the patient 2%. I think different studies have

come up with different values – but we use 1%.

The same issue came up during the interview with Susan:

Researcher: Right, OK.

Do you ever actually, just out of interest, do you ever use numbers, do you ever say I think there is a 50-50 chance or maybe a 40% chance.

Susan: No, because we do not have the up to date research on it. The only time would be in amniocentesis, where we keep, we do an audit, and we have national figures.

In this case I don't know everything about how, based on this, what are the chances of the baby surviving. So this baby needs to be referred to the specialist center. So I would not be able to give them a chance.

The amniocentesis example of using data obtained from the literature was the only one mentioned by the participants during the interviews. It seems that in their professional ultrasound practice participants are happy to work with little recourse to what they regard as “factual” values for chance, hence they must be using their own values to make decisions. However, in undertaking a decision analysis they were reluctant to make explicit their own estimates of chance, and even criticise decision analysis because these estimates of chance are used. To some extent the participants evaluate decision analysis in a manner which they do not use to evaluate their own clinical practice. Dowie (1995) has called this “*partial or non-comparative evaluation (PONCE)*”. As Dowie (1996b) puts it:

To emphasise the weakness of the evidence available for a particular decision analysis,

without giving equal stress to the implications of these weaknesses or absences for other models of decision making, is pure and simple PONCEing.
(pp106)

It was evident in all sessions that participants did not naturally or normally think or work in numbers when assessing chance. Participants found it difficult to work with numbers and the common practice was to first assign estimates of chance using words and then convert these words to a numerical value. Many examples of this process were seen during the sessions, for example from the transcript of the interview with Kate:

Researcher: *Right. Let us start from here. We make the decision to give the limited information. Well tell me, what is the chance the patient would ask for more information in that situation?*

Kate: *I think there is quite a fair chance that they would ask, on the probability,*

Researcher: *On the probability, yes, so what did you say, there is a fair chance?*

Kate: *Yes, yes 0.6 or 0.7*

In this example Kate estimates the chance as “a fair chance” and then with prompting converts this to a probability of 0.6 or 0.7. In the following extract from Hannah’s interview “very low” is equated to 1% or 2%.

Researcher: *So you have to accept that there is no such thing as a perfect test.*

Hannah: *That’s right. Its very hard to put a figure on. I can only go over my experience. I know its very low. But I have made mistakes. 1 or 2% I suppose.*

Yet another example comes from the interview with Penny:

Researcher: So at this point you have got a peer to come into the room and rescan the patient. What is the chance that the peer will agree with you and confirm your diagnosis?

Penny: Well, there's a good chance – a very, very good chance that another sonographer would agree with me. In these cases it would be very unlikely that I would get it wrong. So I am almost sure the other sonographer would agree.

Researcher: So you think there is a very, very good chance that the other sonographer will agree.

Penny: Yes

Researcher: So could you give a probability for that – a percentage value?

Penny: Emm. High maybe 95% - yes 95%.

As already mentioned in section 2.1.5 the use of words to quantify chance is problematic (Dowie 1992, Nakao and Axelrod 1983, Kong *et al* 1986). This study however suggests that people use words to make their initial estimates of chance. Evidence of what Dowie (1992) calls “Numerophobia” is seen in this study. The participants are reluctant to use numbers. They have to be prompted to convert their words into numbers.

When giving the probability task it became evident that one of the key considerations to participants was the reference population. This was a major discussion point during the sessions, with participants being given the freedom to define the population themselves.

In some sessions participants were tempted to use “non-rational” probabilities. A common example was the temptation to assign a 50/50 chance to events. This is seen in the following extract from the interview with Hannah:

Hannah: I am very certain that there is an abnormality because there is indeed the normal view we see, but I am not very certain what exactly the abnormality is.

Researcher: Well, let's just say, an abnormality. so you are very certain. So what would that be in terms of chance, from zero percent to 100 percent, and I know this is really very difficult to do, but where would you put that? Is it a 50-50 chance that it is abnormal, more than 50%

Hannah: More than 50%, more than 50% chance that it is abnormal. I would say that it is about 90, if there definitely is no atrial septum I would say nearly 100% shall we say

Researcher: How nearly?

Hannah: 100%

Another example is seen in the following extract from the transcript of the interview with Penny

Researcher: So let's take a look at this chance node. Here you have said that the patient has become very distressed and they will either ask for information within the scope of the sonographer or out side. What is the chance that they will ask for information outside the scope of the sonographer?

Penny: 50:50 I guess. Yes 50% chance.

Researcher: *So there is a 50% chance that this distressed patient will ask for information that is outside the scope of the sonographer. 50%.*

Penny: *Well I guess if they are really upset they are not going to ask really difficult questions – maybe less than 50%.*

Researcher: *How much less than 50%.*

Penny: *Let me think. Maybe 30% - how does that sound?*

Researcher: *Well it's your estimate – how does it sound to you?*

Penny: *OK. Yes 30%.*

Researcher: *So the value on the other branch must be?*

Penny: *70% - I'm getting the hang of this.*

Researcher: *OK 70% let me just put that in. OK. What about this next node – here there is little overt stress in the patient, what's the chance here that they will ask for information that is outside the scope of the sonographer.*

Penny: *I really think this is 50% this time.*

Researcher: *That's what you said last time – are you sure.*

Penny: *Yes. 50%*

In almost all cases the irrationality of this figure was recognised by the participant and the non-rational probability was eventually not assigned. But it would seem that there is an initial temptation to assign 0%, 100%, 50% and 99%. Researchers and practitioners would be well advised to scrutinise any event that is assigned one of these values and suggest that practitioners engage in a reflective process. It is likely that these

probabilities are widely used in every day language with little thought to the precise meaning and it was pleasing to see that the participants quickly recognised this deficiency when the decision analysis process required them to be more analytical (as would be expected).

8.2.3 Assigning utilities

The example of road crossing was used to introduce participants to the concept of utility. This example allowed for very different outcomes including "on time for an interview", "late for an interview" and "death" to be discussed. Participants were asked to select what they considered to be the best and worst outcomes. The best outcome was given the value of 100 and the worst outcome a value of 0. Participants were then asked to value the other outcomes in relation to maximum and minimum utilities on a visual analogue scale. Because of the time available in an interview complex methods of utility elicitation such as those described by Barron (1994) were not used. The method used worked well for the practical purposes of the study and none of the participants had any problems in the assigning of utilities this way.

The process of introducing participants to utilities and there experience of adding utilities to their decision trees is illustrated in the following extracts from the reports written on the interviews with Carol and Gail. The reports contain some comments and reflection from the author on the process:

The concept of utilities was explained using the road-crossing example. Following this the issue of "health state" utility was covered and some examples given. As with other stages this was undertaken on a white board.

Carol was then asked to add utilities to her tree by trying first to establish the best and worst outcomes. She stated that at the beginning of the process she would have said that the best outcome would have been to be told all, now after drawing the tree this had changed. She now felt that the best outcome was to have the problem discussed and be able to ask questions that were fully answered by the sonographer. She felt that working through the process she could now see how this option would make her more involved with the decision making process and give her more control. After reflection she did not seem to have any trouble in assigning the maximum and minimum utilities to the tree. For this she used the maximum and on minimum utilities as benchmarks and assigned utilities to each outcome in relation to these. The process seemed to follow a pattern that a utility was assigned, reflected on, and then modified.

Carol appeared confident in this aspect of the decision analysis. She felt that her own experiences of being left in the waiting room had greatly influenced the estimation of utility. The best outcome was one that did not involve being left in the waiting room and the worst the one that did. She also felt that even if the process had been very good in terms of giving information this could be scored very badly in terms of utility if the person was left in a crowded waiting room. This is reflected in the utilities given on the decision tree.

The utilities were put on the tree and saved as C9.

Reflections on adding utilities

Asked to reflect on the process of adding utilities to the tree Carol said that she had found the process difficult but did feel that she had managed to grasp the concept and apply it. She had found the process very demanding and difficult to give large values to outcomes, which were in practice very negative.

She did realise that the waiting room experience had had a large impact on her feelings but was happy with this because it had been such a bad experience for her. She did feel very strongly that the values she had used were her own. She had not tried to empathise with the woman in the example and guess what her utilities were. On reflection she thought that some women may not want to know the bad news and would be happy to put off receipt of bad news as much as possible.

She did not feel that she had considered the sonographer at all when estimating the utilities. She could see that some of the outcomes that she had rated low could be considered the best outcome for the sonographer i.e. the patient leaving without asking questions or getting upset. Other patients in the waiting room had also not been considered.

The following is an extract written on the report following the interview with Gail. It is from the part of the interview where she is considering utilities:

Gail took longer to grasp this element of decision analysis than the probability element. Once the concept of utility was understood Gail asked whose utilities she should consider, was she to consider her own utilities or those of the patient? She gave her own answer to this question by stating that "the needs of the patient are foremost in the mind". She felt that if this was not the case it would soon become apparent to the patient in the clinical situation and there would be a loss of trust.

It was interesting that Gail had recognised this issue immediately. On further questioning she felt that one of the most important aspects of her work was to be empathetic with the patient - which she thought was very close to "considering the patients utilities". On further reflection however she also felt that this empathetic utility formulation was tempered by consideration of her own utilities in the situation. For example she would tend to avoid the risk of giving the wrong diagnosis even if she considered that the patient would consider it better to give the information. So in practice she would tend to give information - but as little as possible. This is reflected in the utilities assigned to the tree.

Putting the utilities onto the tree was quite problematic but clearly rewarding for Gail. Much reflection and thought went into each utility. She felt that some of the utilities were assigned for "selfish" reasons. For example the outcome resulting from not telling and the patient not suspecting a problem was given a high utility, because it made for less complex interaction with the patient - she termed it "an easy life". On further questioning about this point she felt that there were no issues of ego in not telling the patient the diagnosis.

The subtree including the events "patient senses a problem" and "patient does not sense a problem" was considered in great detail. This seemed to be because there seemed to be a clear clash between the utilities of the sonographer and those of the patient. Gail felt that it could be best for the sonographer in terms of process if the patient did not sense a problem, but worse for the patient.

Reflections on the assigning of utilities to the tree

Gail had found this a foreign and difficult task. She also seemed concerned that most of the utilities had been assigned values over 50. She was also concerned that many of the values were "estimates". When asked why she was concerned about this she stated that in ultrasound practice she had to be taught to work on facts not guesses.

She felt she would have come up with more accurate values of the utilities given more time. She felt that it would have been better to be given some details of the task before attending the interview. Again she thought that this would make her more accurate. Gail was asked to explain what she meant by the term accurate. She was very unclear about the meaning of this term and could only restate her unease concerning the utilities she had assigned.

The extracts from Carol and Gail's interviews highlight some important aspects of assigning utilities. One issue that is of concern to both these participants is the ownership of utilities. Although Gail notes that she feels that patient's utilities are of

importance she goes on to assign utilities, which are from the sonographer in origin rather than patient. Where Gail attempts to predict the patients values there may be inaccuracy as Seckler *et al* (1991) and Heckerling *et al* (1999) have found that practitioners can not accurately predict the wishes of patients (see section 2.1.6). Carol uses patient utilities by placing herself in the position of the patient in the scenario and giving her own utilities. Both of these participants recognise that that there may be a conflict between the practitioners and the patients' utility values.

In the next extract from Susan's interview she also indicates that she tries to give the patient's value of utility rather than her own:

Susan: I have always put myself in the patient's shoes and I would like to know, and I feel that people cope better if they are informed if there may be problem, or not. So these values are based not just from my experience but from talking to patients who I have called back for follow up.

Another extract from Penny's interview also shows that there is difficulty in assigning utility values due to confusion regarding whose values to use.

Researcher: *OK, good. Now let's look at this outcome here. In this case you have called a peer in. They do not agree with you so the patient is sent for an anomaly scan. There are two outcomes the anomaly scan either agrees with you or your peer.*

Penny: *This is a difficult one!*

Researcher: *Why?*

Penny: *Well if the anomaly scan agrees with the other sonographer*

Researcher: *Your peer?*

Penny: *Yes. Well you're going to look really stupid. You really should get this one right every time. It would wipe out trust with the patient and other staff. But on the other hand it would be really good for the patient to have the scan and find there was no problem.*

Researcher: *So what value are you going to put on this one here (points to outcome of the anomaly scan confirming the peer's diagnosis)*

Penny: *Well it has to be high I guess for the patient's sake. A healthy baby I suppose so 100 I guess, even though it will look bad for me.*

Researcher: *And this one? (points to the outcome of anomaly scan agreeing with her diagnosis).*

Penny: *Well this one is good for me – but bad for the patient so I suppose 10.*

Researcher: *You don't look very happy.*

Penny: *Well I suppose it depends on whose values we are talking about.*

Researcher *At the beginning I think I asked you to consider the decision from the sonographer's perspective.*

Penny: *I know you did. But I guess the patient's values are more important than the sonographers. At times like these I think the patients and sonographers values should be the same.*

Researcher: *So you are happy with 100 and 10?*

Penny: *Yes*

It is clear that the participants find it very difficult to assign values for utilities. The main problem that they encounter seems to be ownership of the utilities. The sonographers use

either their own values or try to second-guess the patient. The patient used her own values for utility and substituted these for the patient's utilities. This was not a strategy used by any of the sonographers. In terms of using decision analysis as a research tool the final value decided on for the utility value is of little importance. What is of importance is that this important issue for the health practitioner is made overt and can be studied.

8.2.4 Expected utility.

Once participants had completed adding utility values to their decision trees the concept of expected utility was explained. As with the other elements of decision analysis the road-crossing example was used. The expected utilities on the participants' trees were calculated using a "roll back" procedure carried out by computer program.

It can be seen from the final trees produced by the participants (Appendix 3 – Appendix 8) that the decision that all participants, except Penny's structured was basically a decision regarding the giving of information. The branches emanating from the origin decision node and the corresponding expected utilities are shown in the table 7.

| Participant | Branches from origin decision node | Expected utility branch |
|--------------------|--|--------------------------------|
| Carol. | Refer patient to doctor. Do not state nature of problem to patient | 20 |
| | Say nothing – normal process | 37 |
| | Discuss possible problems | 100 |
| Gail | Tell patient all | 90 |
| | Give no information | 56 |
| Kate | Give simple explanation judge understanding | 78 |
| | Give full information | 67 |
| Susan | Give limited information | 51 |
| | Tell patient | 32 |
| Hannah | Not tell | 28 |
| | Say something | 38 |
| Penny | Say nothing | 36 |
| | Give some information* | N/A |

Table 7. Expected utilities from the in-depth interview

*Penny’s final decision tree (Appendix 5) shows that at the origin decision node she only has one option – to give some information and then ask for a peer to come and rescan the patient. This branch terminates with a chance node with branches for “Peer unavailable” and “peer unavailable”. If the peer is unavailable there is an embedded decision node with has choices of “give full information” and “give no information”. If the peer confirms the initial diagnosis then there is a decision node with choices to “give full information” and “give no information”. At first sight the final decision tree produced by Penny may appear different to the basic structures produced by the other participants, but this is not the case. All final decision trees produced by the participants give a basic choice regarding the giving of information to the patient.

For all participants the expected utility giving the patient information was higher than not giving information. When asked if this result agreed with their intuitive feeling all

participants said that it did and they would all intuitively make a decision to tell the patient.

The following extract is from the report written after the interview with Carol.

Using the computer program the expected utility for C9 was calculated. Two of the probability values were found to be missing at this stage and these were added. The computer then calculated the expected utility values.

The expected utility values came as no surprise to Carol as they agreed with her intuitive decision for this scenario. It became clear after some discussion that she did not fully understand the concept of expected utility. Her main problem seemed to be that she did not understand or accept a technique, which could possibly advise on making a decision, which could result in the worst possible outcome. At this stage the researcher referred back to the example of crossing the road. Carol was shown how when we choose to cross a road we are making a decision to follow the course of action that could result in the worst possible outcome i.e. to be run over and killed. After further reflection the concept of expected utility seemed to be better understood.

In the following extract from the interview with Susan it is interesting that she not only states that the decision analysis agrees with her intuitive decision, she also states that the ratio between the expected utilities also seems to agree with her strength of feelings about each of the options.

Researcher: Now what this has done is to work out something called the Expected Utility. And the expected utility for telling the patient is 84. The expected utility for not telling the patient is 18.

Susan: Right.

Researcher: *I am just going to save that as Number 4. and basically what expected utility is, it tells you that if you make that decision you can expect to do best. It doesn't necessarily say that you will do best, because sometimes you have the worst possible outcome and the best possible outcome, but it gives an indication statistically, probability wise, you are best to go that way. So in fact in this case the decision analysis agrees with your, if you like, intuitive decision that in this case with this amount of data I would tell the patient. So the analysis agrees with you.*

Susan: *Right.*

Researcher: *What do you think about that?*

Susan: *I think it is pretty good, because it is what, how I would deal with it, and it has told me I'm really putting to value... in my mind I would, I would give it an 80 : 20 sort of ratio.*

The next extract is from the interview with Penny. In this extract she states that she does understand the concept of expected utility.

Researcher: *So you get the idea of expected utility from the crossing the road? Can you see that the logical course of action is to go down the path that gives you the maximum expected utility?*

Penny: *Yes. Not cross the road and be late for the interview.*

Researcher: *Yes in the case of your tree with your values correct. OK lets take a look at your tree on the screen. We're lucky because we don't have to do all the maths on this one – the computer works it out. Just give me a minute to set this up. OK there we are. This*

is a little complicated because you effectively start with a chance node – bring the peer in – peer available, peer unavailable. Now if look here if the peer is not available then the expected utility for not giving information is 0 and for giving information is 8. Now at this point where the peer confirms your diagnosis the expected utility for giving a full explanation is 9 and for not giving any information and referring to a doctor is 0. So this decision analysis tells you if a peer is unavailable to give a full information and if a peer confirms your diagnosis to give a full explanation. How does that feel?

Penny: Well it feels fine! I think this is what I would do in practice so I have no problem with this.

Researcher: So you are happy with the analysis.

Penny: Yes. But it does seem to be a very complicated way to go about doing what I would do anyway. Very complicated.

The sections of the interviews, which dealt with expected utility, were in some respects of least value. The expected utility was calculated and the participants stated how this related to their intuitive feelings about the decision. It may be that expected utility is one of the most difficult aspects of decision analysis for participants to grasp in the time limits of a research interview. When using decision analysis as a decision aid the calculation of expected utility is the climax of the whole process and the one that gives advice on the decision to make. When using decision analysis as a research tool it is of less importance. More data was forthcoming from the participants in the earlier stages of the decision analysis than in this later one.

8.3 Conclusion

The interviews conducted in this part of the study demonstrated that decision analysis could be used as a research tool to structure interviews. Simple decision analysis could be taught to participants within the time limits of a research interview. All stages of decision analysis yielded useful information about decision making and judgement within sonography. This was mainly because decision analysis makes people stop, think and reflect on decisions that they would normally make intuitively. A comment made by Hannah is particularly relevant:

It (decision analysis) makes you really sit and think about something that you do fairly automatically. To be honest, you don't have all this stuff going through your head when your doing a scan and you see something it all goes through your head but it goes through so quickly because you don't have much time. This makes you actually sit back and think about something that you do fairly automatically.

The key strength of decision analysis as evidenced by Hannah's comment is that it allows reflection on intuitive process. Decision analysis could well become a much more widely used tool in research into intuitive clinical practice.

Chapter 9

The nature of decision making and judgement in radiography

9.0 Introduction

The previous *chapter* was concerned with how participants were introduced to decision analysis and their experience of undertaking such an analysis within a research interview. It concluded that decision analysis could be used as a research tool to structure in-depth interviews. This *chapter* discusses the findings of the six research interviews undertaken using decision analysis. The findings of the interviews are presented in three *chapters*. This *chapter* is mainly concerned with the research question, “*What is the scope and nature of clinical judgements and decisions in radiography?*”

The method used to analysis the data is discussed in *chapter 7* section 7.2.6. The data was classified into groups that added to the understanding of the nature of decision making and judgement. The areas that were chosen for consideration are decision identification, the level of certainty regarding diagnostic accuracy, the decision making environment, and the impact of experience.

9.1 Decision identification

The scenario used in the first round of in-depth interviews (see section 7.2.1) was developed in light of the experience gained during the earlier stages of the research. The researcher designed this scenario to include what he considered was an obvious choice - tell or not tell the patient the diagnosis. He thought that once participants had identified this decision they would then consider the chances of the information given being true or false. Before conducting the interviews the decision tree that the researcher expected to be generated by participants was similar to the tree shown in figure 20 in section 7.2.4.

However, if the decision trees produced by the participants from the first round of in-depth interviews are studied (Appendix 3-6) it is found that the trees bear little resemblance to this. The participant's trees are more complex. The trees do not indicate that the participants have considered the possibility that there may be a misdiagnosis. It is also noteworthy that only Carol (the patient) included chance nodes that demonstrated that she had considered the possibility of a misdiagnosis (See trees C1-C9 Appendix 3). Because of the complexity of the trees some fundamental issues were masked. For this reason in the second round of interviews the participants were prompted by the researcher (Using Decision tree 20 shown in section 7.2.4) to keep their trees simple. The trees produced as a result of the second round of interviews (Appendix 7 and 8) are indeed simpler but it should be noted that their structure was constrained by the researcher.

The decision that the researcher thought was obvious in the scenario was however not apparent to the participants. In the sessions with the ultrasound practitioners an initial difficulty was that they did not recognise the choice to be made or the possibility that they may get the diagnosis wrong. There was failure to see that there was a decision to be made i.e. tell or not to tell. The following example comes from the taped session with Penny and shows evidence of her difficulty in defining the decision:

Researcher: Well what are you going to do?

Penny: What am I going to do? How am I going to say it to her do you mean? What am I going to tell her? Or what is my first reaction?

Researcher: What's the decision to be made, or is there a decision to be made?

Penny: Well yes you sort of have to break it to her gently, that there is something wrong with the baby. I would say I was having trouble measuring the head, to start with. That would be my first statement, just to sort of put in the initial idea that there is something wrong. But not exactly what was wrong. I would not say that I couldn't see the head, or that the baby has no head at all, or that I can't see the cranium. I would just say I was having trouble measuring the baby's head, or that it is difficult to see at the moment. I would expect another question from her at that stage like, 'what do you mean you can't see the baby's head. Actually what we would do in the department is to get somebody else in to check, to verify that that really was the case. I would get a colleague in from next door to see if they can get a better position on the baby to measure it, as I couldn't sort it out as it was difficult to see, to verify exactly what we thought. Then I would turn to the lady and say exactly what the

problem was, that the baby's head had not developed properly. Really in this situation maybe she needs to be counselled by a midwife and we would have to get her over to the Obs department.

The idea of introducing peer-aided judgement seemed to mask the fundamental decision that was required. When this was explored with Penny there was further reluctance to acknowledge that a decision to tell or not to tell was required. Although this became apparent later in the interview with Penny as demonstrated in the following interchange:

Penny: You've got to be careful about stepping out of your area I think basically.

Researcher: Yes. But you are making judgements all the way along about what you are being asked, what your perceived scope is I suppose.

Penny: Well yes, how far your role goes.

Researcher: Do you think that it varies much amongst sonographers?

Penny: Yes I do. I mean not everybody would deal with this in the same way, Not everyone would tell the patient. When it comes to this area everybody does her own thing

Penny clearly indicates that sonographers don't always tell their patients the diagnosis and that sonographers are free "to do their own thing" within the boundaries of this decision making scenario. This indicates that Penny has made a decision with regard to this scenario i.e. to tell the patient. Even though Penny clearly makes a decision she does not recognise that she has made it. This decision is not evident in the structure of the decision trees that she produced during the interview (Appendix 5).

Penny's failure to recognise the decision that she was making may have been due to the fact that she was following a procedure or protocol. This possibility was shared with Penny during the interview:

Researcher: I get the feeling that you are following protocols, but they are not, external protocols, they are protocols that you have set up for yourself? You seem to have very strong...

Penny: Commitment?

Researcher: Yes. Belief that this is the way that you should treat patients and this is the way you are going to do it. It is quite difficult to see where the decisions are. Because sometimes you are actually making a decision but you are so sure about this decision that you ignore that there are any other options. Take this branch on your decision tree "give information" – you do have an option here to give no information – but you do not even consider it so you may not recognise that you have made a decision.

Even after this very strong prompt there is nothing in the transcript from the session to indicate that Penny recognises that by giving information to the patient that she has made a decision. The researcher came to the conclusion that the sonographers were following a protocol of their own making and this masked the decisions that they were making. This was confirmed during the session with Kate.

Researcher: OK, so you have got some decisions to make about how you are going to handle the situation, what are you going to?

Kate: Well we usually start talking. Well what I do is start talking, sort of ask them if there are any problems if everything has been going OK through the pregnancy. If they

have been to see the obstetrician, and everything was OK, sort of booking clinic and things like that. Then I just say that there is something that I have found, something that is not quite right. Usually we have somebody in the department, a clinical assistant, who we can call for help, and because they can actually counsel the patient, tell them. We don't tend to send them to St Mary's because this is a serious abnormality and you can actually see it.

This extract comes from the beginning of the session with Kate just after she has been presented with the scenario. It is clear that she does not explicitly identify any decision to be made or that there could be a chance of misdiagnosis. Kate states that she will tell the patient that “something is not quite right”, but she does not recognise that she is making a decision at this point. Like Penny, Kate mentions bringing in another practitioner, in this case a doctor not a peer. Kate perceives a different role for the other practitioner, She says that the doctor will be able to tell the patient and counsel them.

Kate was prompted a little further to discover if she could identify decisions that had to be made as a result of the scenario:

Researcher: Is there a decision to be made? Are there various paths that you can take forward?

Kate: You mean whether we tell them or the doctor tells them? I mean they have got to be told, there is no point in carrying on any further with the pregnancy if there is a problem, and they have got to be told that the foetus won't survive when it is born. So either they have a termination or go through the pregnancy. Because some people do I have had some who do because of their religious beliefs not want a termination, so they carried on with the

pregnancy. Even though the baby couldn't survive. I think they have to be told, so it's really who tells them.

In this extract Kate does identify a decision to be made, but it is not whether to tell or not to tell but who is to tell. It could be that Kate is using this tactic to avoid acknowledging the decision that she is being asked to make. After this section of the interview Kate was asked to confirm that this was the nature of the decision to be made:

Researcher: *Ah right, so at this point we haven't got a decision to tell or not tell. We have to make the decision, whether you are going to tell or whether you are going to get someone else to tell. Would that be right?*

Kate: *Yes, but I think in most of the cases we tell. Because these days they want to see the scan, they want to know if the baby is OK. So to start off you have to say I have got to take some measurements and check all this with the details and then I will turn the screen round so that you can have a look at the baby with your partner. So first of all you have got to check that everything is OK and at 18 weeks you should be able to see the skull outline and, with an anencephaly there is not, no way that you can miss that.*

Here there is a level of certainty over the diagnosis and no conscious recognition of the decision that needs to be made - only a statement that they will usually tell the patient because they want to know.

9.2 Level of certainty regarding diagnostic accuracy

One of the most striking features of the first round of interviews with all three sonographers, they did not consider the possibility of assigning a wrong diagnosis. The sonographers' failure to recognise the uncertainty of their diagnosis may be an artefact of the method used. It may be that the abnormality chosen for the scenario seemed so unequivocal to participants that they did not feel that they could make an error in this diagnosis and therefore they assumed that their diagnosis must be correct. With the exception of Penny all sonographers structured their decisions with no reference to the chance that their diagnosis could be wrong. Penny did bring in a peer to confirm her diagnosis but on questioning it was established that this measure was taken to reassure the patient rather than a genuine acknowledgement of Penny's fallibility. This indicates that the practitioners may have an over confidence in their diagnosis of this condition.

When questioned all practitioners stated that there was no chance that they could get this diagnosis wrong, i.e. they felt that there was a 0% chance of misdiagnosis. Even when they were asked to reflect on this assumption of infallibility they were very reluctant to consider that they could be wrong. All of them stated that this anomaly was easily recognised that they could not possibly misdiagnosis it. This level of certainty is demonstrated in the following extract from the transcript of the interview with Penny.

Penny: I am definitely sure, in the case of anacephely. It is not sort of iffy like, if the heart is right, or if it might be anacephelic, or if the position isn't quite right, I mean it is a definite there is no cranium there. You

know this baby is jumping around, the eyes are bulging at you, it is a definite

Researcher: So there is not even a judgement to be made here whether it is anencephaly or not, or decision?

Penny: I will be quite happy to say at 18 weeks if the baby is anencephalic if I have got all those criteria available on screen to me.

This is in marked contrast to the views of the patient (Carol) who stated that the sonographers could get the diagnosis wrong as one of her opening statements. There follows an extract of from the report written on Carol's interview:

At this stage Carol considered the structure of her decision tree. One of the first points made was that there is a chance that the sonographer could get the diagnosis wrong and she felt it important that this aspect be considered in the structure of the tree. After some consideration she came up with five possible courses of action that the sonographer could take:

- *give no information and refer to GP (this reflects what had happened to her during her first pregnancy)*
- *say nothing and go through the normal process*
- *discuss the problem with the patient and allow them to ask further questions*
- *tell the patient everything (intuitively Carol thought that this was the best option at this stage.*
- *refer the patient to the outpatients clinic without giving any information.*

These options were modeled using the computer, the possibility of the sonographer misdiagnosing the condition was also included in the structure of the tree.

The belief that the sonographer may misdiagnose the condition is also seen in the first trees that Carol drew (C1). It is interesting to note that this basic structure is lost by the

time Carol draws her 5th tree (Appendix 3 C5 and Figure 19) when the decision becomes based on what to tell the patient.

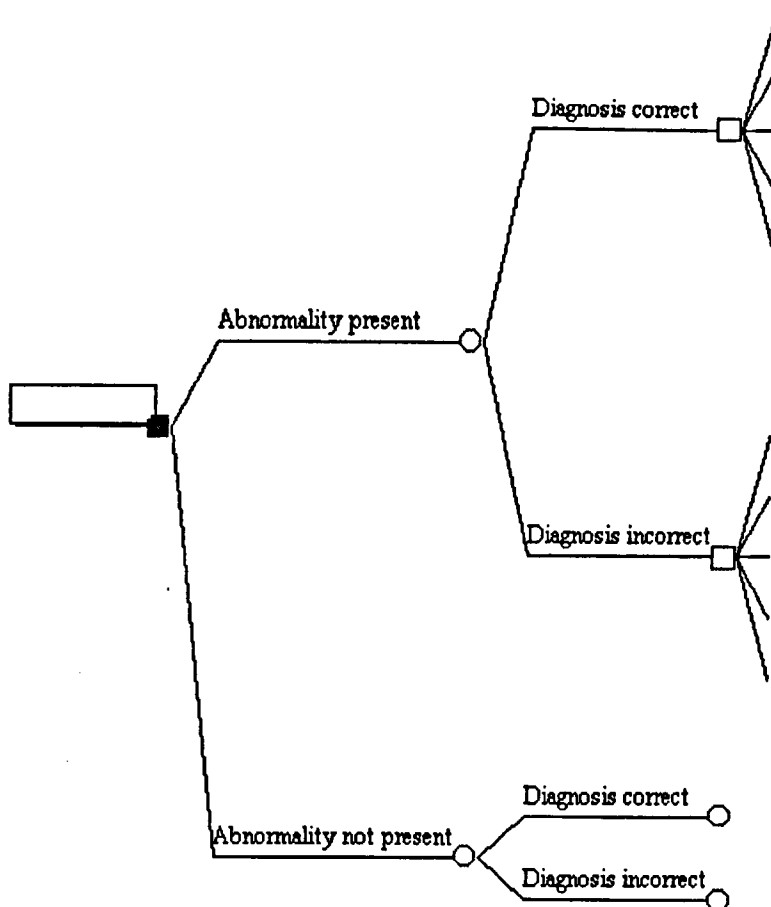


Figure 19 Part of C1 Shown in full in Appendix 3

Even though the chosen example would justify a high degree of certainty it seems that the sonographers interviewed are over-confident in their ability to diagnose. It may be that sonographers may, for psychological reasons have to work under the assumption that they are correct when they feel certain.

9.3 The decision making environment

The scenario used in this stage of the study was intentionally limited. It became evident that participants wanted more information in terms of the environment in which the decision is made. When extra environmental information was not forthcoming participants were observed supplying their own environmental information. All participants needed to put the decision into a context before they could address it. An example of this in terms of the personal background of the patient is demonstrated in an extract from the session with Penny:

Penny: It always depends on what kind of patient you have got, doesn't it really, how much they have read up.

Researcher: Have we got anything here, what do we know about this patient? Mrs Jones, 35.

Penny: One child, so she is pretty 'genned up' on things really.

Researcher: Anything else?

Penny: But she has a child already, so she knows processes, and, she is not a youngster, you know she is not 19 or something, you know quite in touch with the world.

In this example from the briefest of information it is seen that Penny comes to the conclusion that the patient is “genned up”, knows the process and because she is not 19 she is “in touch with the world”. Penny made generalisations based on assumptions about the patient.

The interview with Kate highlighted another example of additional information being produced by the sonographer. In this case the information relates to the physical environment in which she normally works, and the decision that she is making in the scenario as is indicated in the following extract:

Kate: Ideally, we would have a room where you could actually put them away from the rest of the patients, but we don't have a room, we have a little corridor. I think what we would have to do is, to get them around to the antenatal clinic, at least they have a room, or if not a free cubicle where the midwives could talk to them while they are waiting for their partner to come in. All we have got is the ultrasound room and a little corridor with a few chairs and then a waiting room outside the corridor, so you couldn't really send them back on their own to there. And you have to carry on, you have other patients waiting, building up, so you have to actually call the midwife. We do have first stage delivery suite which if the room is available they could take them in there and wait for their partners there.

Here, Kate paints a picture of how patients are dealt with in the department in which she works. She then uses this information to structure the decision analysis.

Earlier in this study it was established that the decision making environment of sonographic practice is complex. Guidelines, policies and professional constraints impact on sonographer's professional practice, as does the physical environment. It would seem that the practitioners are uneasy making decisions when information about these is not available. When this is the case sonographers provide this background data for themselves from clinical experience.

This need for information regarding the policies employed by the department is seen directly in the following extract from the report of Gail's session:

It is interesting to note that as soon as this question was put, Gail raised the issue of policy. Her precise answer was 'that depends on the departmental policy'. She wanted to know what the policy was in the department involved in the scenario. Her direct question was not answered but the researcher opened up a discussion about policy.

Gail felt that the worst possible policy for the sonographer was one where the radiologists and/or the obstetricians did not allow the sonographer to give information to the patient. This could often leave the patient feeling that there was nothing wrong with the developing child. On the other hand patients might sense that there was a problem but their suspicions were not confirmed, leading to anxiety and distress through uncertainty. Many women asked questions about the image and sonographers working under this type of policy would often have to tell half-truths in response. This could often lead to women not knowing what to believe next time she was examined.

Gail went on to outline the policy in her own department. In her department the partner is allowed into the examination room from the start of the examination. She felt that this seriously changes the dynamics of the sonographer/patient relationship. The patient is warned that a full scan will be performed and that at times this will be technically difficult for the sonographer, so that she may well frown. The patient is reassured that this often happens and does not mean that there is a problem with the developing child.

The importance that the decision maker placed on contextual factors is seen particularly well in the interview with the patient Carol. In her case her past experience had a major impact on the decision making process. Immediately on being given the scenario she sought background information and when it was not forthcoming she said that she could picture what had gone on before the scan.

The scans could not be taken in isolation and one had to consider what had gone before the scan. These could be considered inputs into the process. In her case the treatment by her GP had had a great impact on the decision making and judgement process in the scanning room. She did acknowledge that on reading the scenario she could form a picture of what had preceded this case. This is interesting because the scenario gave very little background information, but she was able to supply extra information to help her understand the situation. The contextual information that was invented by Carol was based on the experience of her own scans. It became evident that this contextual information had an impact on the decision analytic process decision.

In most cases sonographers would be able to access the background information they sought as part of the scanning procedures, i.e. they could ask the patient or consult patient notes. It would be interesting to discover what sonographers do when this background information is not obtainable, as in this study. From the evidence of this research it would seem that they construct such information and this would have an impact on the way they would undertake a decision analysis.

9.4 The impact of experience

Past experience clearly had an impact on the decision process. The impact of past experience is most obvious in the interview with the patient. It was very evident that she identified closely with the patient in the scenario and was empathic towards the patient. This gave insight into the decision making process from the patient perspective. It seems that to gain such insight, scenarios have to be realistic and relate closely to the subject's own experience. Her experience of being left in a waiting room when very distressed had a profound affect on all aspects of the decision analysis, particularly the

assigning of utilities. This indicates that it is important to include patients in the formulation of policies and protocols because they have a unique perspective. However their contribution must also be considered in relation to their limited experience and hence difficulty in assigning probabilities, if decision analysis is being used to formulate policy.

The impact of past experience was also observed in the decision processes undertaken by the sonographers. Kate makes reference to patients that she has scanned before:

Kate: I have had some (patients) who because of their religious beliefs do not want an abortion, so they carried on, even though the baby couldn't survive, but I think they have to be told, so it is really who tells them?

And later in the interview Kate also shares her experience of breaking bad news and the response that she as received from the patient.

Kate: Yes, some people don't seem to get upset. They seem to think, you tell them that something is wrong and they say, well the baby is all right isn't it, and you think well they haven't taken that in and you have to explain to them again, and then you feel maybe someone else should see them too.

All of the sonographers did try to consider the situation from the patient's perspective and on a number on occasions practitioners could be seen trying to assign utilities which would mirror those of the patient rather than their own. It seemed that when undertaking decision analysis sonographers tried to act as patient advocates and that this role came

quite naturally to them. But, from a decision analysis perspective it is difficult to see how sonographers can be adequately reflective and empathic in their practice if they do not directly elicit patient's utilities rather than simply second guessing them. Decision analysis is clearly an excellent means to bring the patient and the sonographer together and aid the development of reflective practice.

9.5 Conclusion

There is no pretense that this study has completely determined the nature of decision making and judgement in radiographic-sonographic practice. It has, however, identified a number of issues which do seem to be important in this field of professional practice and that are worthy of further study.

The areas of decision identification, the level of certainty regarding diagnostic accuracy, the decision making environment, and the impact of experience are all of vital importance in decision making and judgement. From the evidence presented in this *chapter* it seems that sonographers have problems in identifying that they are making decisions or articulating that they are decision makers. It is also likely that they are over confident in their ability to make diagnoses. Decision analysis is a process that makes these two issues overt. Once they are overt then sonographers can begin to take steps to improve this area of practice.

The impact of past experience is important. It would seem from this study that when sonographers are lacking information they produce it for themselves based on past

experience. This may well be an essential aspect of professional practice. Once again decision analysis has made this covert process overt. By considering this phenomenon sonographers could become more aware of the assumptions they are making and improve the care that they give to their patients.

Chapter 10

How decisions and judgements are made

10.0 Introduction

This chapter sets out to address the principal research question, “*how are these judgements and decisions made in radiography?*” This question is addressed within the context of sonography and the breaking of bad news, but, the issues considered in this chapter could well be studied in other areas of radiography and for that matter in other health care professions. The evidence presented in this chapter is in the form of extracts from the reports written on the first two interviews and from the transcripts of the other four interviews. The method of data analysis was outlined in chapter 7 section 7.2.6. Hammond’s cognitive continuum is used as a theoretical framework to discuss the findings from the interviews.

10.1 Modes of cognition

Hammond’s (Hamm: 1988) cognitive continuum, introduced in chapter 2, can be used to demonstrate the range of cognitive approaches available to the practitioner, incorporating different balances of intuition to analysis. In these interviews participants revealed a range of modes of practice. This concurs with work carried out by Leaper (1972) who found that doctors did not use one form of decision making, but used a range of strategies depending on the decision making task. The range of decision making

modes is now illustrated with examples from the interviews. Examples of intuition, peer-aided and systems-aided decision making and judgement are recorded.

10.1.1 Intuitive judgement and decision making

Returning briefly to the observational stage of the study of ultrasound, many judgements seemed to be made very quickly with no reference to other practitioners or formal analysis. They seemed to fit an intuitive model of decision making, the characteristics of which were discussed in chapter 2. During the interview stage of the study fast intuitive decision making and judgement was also encountered frequently.

An example of very fast intuitive judgement is seen at the beginning of the interview with Hannah. She was asked to make a judgement regarding the image that she is given.

Researcher: So what do you think about this image?

Hannah Well it doesn't look normal. It doesn't look normal to me from what we've got here.

This reply was given instantly. Within less than one second Hannah made the judgement that the image shown demonstrated an abnormality. This is probably the most important judgement made during the interview and much of the decision making that takes place subsequently based on this judgement. There was no time for detailed analysis of the image to take place. From the authors knowledge of sonography education it is known that when teaching radiographers and sonographers how to make assessments of images they are taught to study the image in a systematic manner but Hannah demonstrates here that no such system is being used.

Those who advocate intuitive judgement as the epitome of experience would argue that this form of judgement would be expected of Hannah since she is an experienced practitioner operating as an expert. Using the Dreyfus (1985) model of the key aspects of intuition Hannah is using “pattern recognition” to assess the patient’s condition. Benner (1987) states that “context free criteria or lists are never adequate to capture either essential relationships or subtle variations in pattern”, and would support Hannah in rejecting the analysis based approach of her training and to use and trust intuition. Another of Dreyfus’s key aspects of intuition that is evident here is “similarity recognition”. Hannah seems to be using experience of similar cases that she has seen before. Similarity recognition however implies slightly lower intuition to analysis ratio than pattern recognition in terms of the cognitive continuum.

In chapter 3 it was noted that a weakness of the “paper patient” approach to decision making research was that it may not capture what actually happens in clinical practice. In the case of Hannah it is just possible that in clinical practice Hannah would not use an intuitive approach, but would have used the systematic approach of her training. But in the light of the observations of the clinical practice considered in chapter 4 this is thought to be unlikely. During the interview with Kate some insight into how judgements and decisions are made in practice was gained. In this extract the researcher is reassuring Kate that she has ownership of the decision tree and can model it however she wishes. Her response is enlightening:

Researcher: Remember this is your decision tree, so you can do anything with it.

Kate: Yes. I was just thinking about it. I mean at work you go through your scanning

session and you don't actually analyse it, you don't actually think what steps to take, and you just tend to react intuitively.

Kate is finding the decision analysis task difficult because this is not what she would do in professional practice. She states, in practice she would use intuition to make the decisions. At this point the research is forcing the sonographer into working analytically which, from this extract, seems to be quite foreign to Kate. The statement from Kate that “you don't actually think” concurs with the “sixth sense” as described by Benner (1987).

During the in-interview session with Hannah a similar statement is made regarding the process used to make judgements and decisions:

Hannah It makes you really sit and think about something that you do fairly automatically. To be honest, you don't have all this going through your head when you're doing a scan and you see something it all goes through your head but it goes through so quickly because you don't have much time. This makes you actually sit back and think about something that you do fairly automatically.

In this extract there is an implication sonographers practice without “thinking”. If they are practising without “thinking” - and it can be assumed that they are successful in their professional practice since they have become senior sonographers - then there must be cognition taking place. This would seem to be intuition. It is interesting that subjects evaluated the use of intuition as being “without thinking”.

All of the sonographers interviewed (both structured and unstructured interviews) were experienced imaging professionals. All of them had spent at least two years training as radiographers, two years in radiographic practice, two years training as sonographers and two years as sonographers. It is also known that they had all been taught to make judgements of medical images in a systematic manner. It could therefore be argued that these practitioners had followed the progression postulated by Benner (1984) and progressed from novices to experts and hence from analysis to intuition. Benner postulates that as practitioners gain experience they move towards becoming experts and also move from using analysis to intuition. Benner's work in this area is prescriptive as well as descriptive. In both "From Novice to Expert" (1984) and her later work with Hooper-Kyriakidis and Standard (1999) she positively advocates the use of intuition.

However the situation may be more complex than the advocates of intuition and the subjects themselves suggest. Even though these sonographers were all experienced and would be classified as experts by Dreyfus and Benner, we found that they did use other modes of judgement and decision making. The following sections demonstrate that these practitioners also appear to use peer-aided and systems-aided judgement.

10.1.2 Peer-aided judgement and decision making

Hammond's 5th mode of cognition is peer-aided judgement and decision making. In this type of decision making and judgement the judge or decision maker typically makes use of another practitioner to aid them in their judgement. Traditionally in medicine this has been referred to as the "second opinion" formal or informal. McSherry *et al* (1997)

states that the formal second opinion “confers both cognitive and psychological beneficial effects”. Within radiology there is a move towards second opinions to aid radiologists both in the form of telemetric links between doctors (Kovalerchuk 1998) and accessing second opinions from computers by having second readings of radiographs made by computers (Karssemeijer and Hendricks 1997). Within the field of allied health the health care professional is often required to defer a decision to a medical practitioner. Medical images are often taken to a radiologist to make a judgement.

The changing and expanding role of the radiographer and sonographer was discussed in Chapter 1 and the relationship between the medically and non-medically qualified health care professional is clearly complex. This leads to complications when trying to classify the mode of cognition used by sonographers. However, often what appears to be “peer-aided decision making is actually deferment of the decision to the medical practitioner. When the decision to be made is outside the normal scope of the sonographer’s professional practice this can be considered to be referral, but when the decision is within the scope of the sonographers professional practice it can be considered deferral. For the purposes of this research peer-aided decision making and judgement is defined as what occurs when a sonographer asks for the opinion of another sonographer to assist them in making their own judgement. Using this definition “peer-aided” has its literal meaning i.e. it relates to the interaction of professionals of the same status. When the two professionals have greatly different status i.e. the radiographic trained sonographer and the medically qualified radiologist then the decision or judgement is being deferred rather than made in a peer-aided manner.

During the observation of ultrasound practice a number of cases of peer-aided judgement were observed. This usually consisted of a sonographer requesting the presence of another sonographer in the examination room for the purpose of giving a second opinion on the appearances of a scan. It is interesting to note that, on the other hand that during the interviews, both structured and unstructured, it was comparatively rare for the sonographer to suggest that they would ask for a second opinion from a peer. During the course of this research differing attitudes towards peer-aided decision-making and judgement were identified.

Participant sonographer Kate however, did not feel the need to ask another sonographer to confirm her findings. However while she did not mention seeking a second opinion from another sonographer she does at one point in the interview say that she might send the patient for a second opinion. It will be seen in the following extract that she then qualifies this statement by saying that if she considers the abnormality gross she would not refer the patient.

Kate: Depending on what abnormality it is, if it is cardiac we you know, we can see that bit is abnormal in the heart but you can't say what it is because you are not specialised in, so you would have to refer them to another place where specialists....

Researcher: So there are some decisions on less categorical diagnose, but on this one?

Kate: On this one you don't need to send them because the abnormality is so great and the structure defects are obvious.

This approach is also seen in the following extract from the notes made on Gail's interview:

In a case such as the one in the scenario which Gail described as "cut and dried" (no uncertainty) the patient would be told about the problem at once. If the case was less certain a second sonographer would usually be brought in to check the findings.

The degree of confidence that the sonographer has in her own decision seems to determine the likelihood that a second opinion will be sought. In the case of Kate this will be a specialist medical opinion and in the case of Gail it will be from another sonographer.

As a patient, Carol found during her own traumatic pregnancy that the delay between the first sonographer making the initial diagnosis and the second practitioner arriving to confirm this diagnosis was the most traumatic aspect of the whole examination if not the whole pregnancy. During the interview with Carol she stated that the patient should not be left with even a few moments of uncertainty. If a peer-aided judgement or decision is to be made then there will always be some delay in gaining the second opinion and hence some time of uncertainty. This is the price that must be paid for the greater analytical content of peer-aided judgement.

The session with Penny gives some interesting insight into the use of peers in the practice of ultrasound. Early in her session it seems that peer-aided diagnosis is common and "normal":

Penny: ...actually what we would do in the department is to get somebody else in to check, to verify that really was the case. I would get a colleague in from next door to see if they can get a better position on the baby to measure it, as I couldn't sort it out as it was difficult to see, to verify exactly what we thought.

And the importance of peer-aided judgement is evident in the first decision trees that she draws where the peer is being used in a typical peer-aided manner this is shown in Figure. 21.

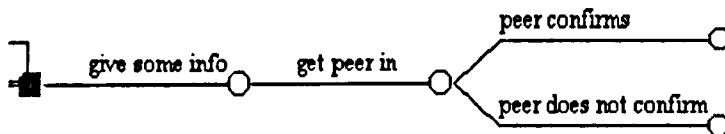


Figure. 21 Tree P1 taken from Appendix 5

In her later trees the input of the peer remains central and consideration of the availability of the peer is included. This is shown in all trees from P2 - P9. P3 is typical and is shown in Figure. 22.

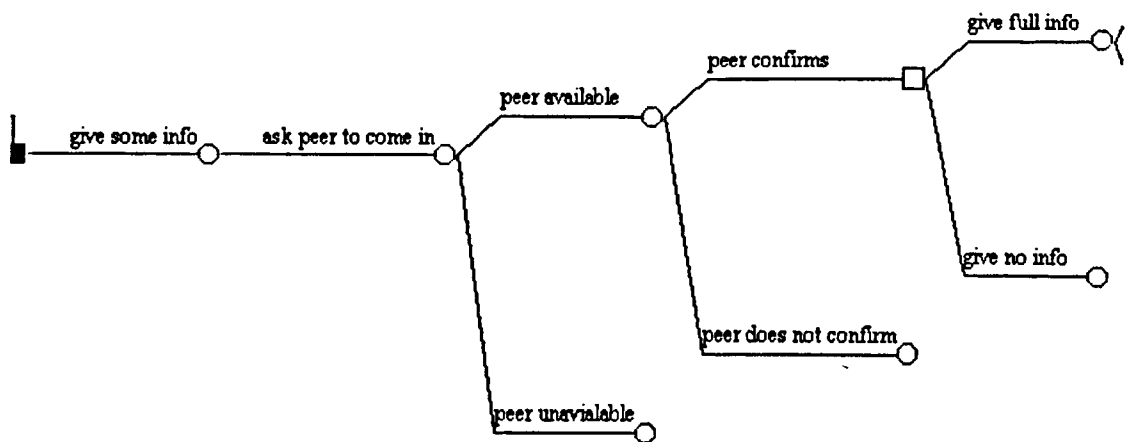


Figure 22 Part of tree P3 shown in full in Appendix 5.

From trees P1 - P9 it appears that the decision on what to tell the patient is only made after a peer is consulted. From simply examining the decision trees the role of the peer would seem to be pivotal. However it became apparent later in the session that the peer was not asked to participate in the decision making process, but is rather being asked to take part in a process which is aimed at comforting the patient and increasing the credibility of Penny's personal judgement:

Penny: *It is verifying it really for the sake of the patient. So that you are not being blasé that you think there is something wrong with it, you know, because you don't want her to think that you have made a decision without going through more channels for her sake.*

Researcher: *So are you always going to get a peer in?*

Penny: *Yes*

Late in the interview Penny comes back to this point, Penny feels very strongly that the “second opinion” is for the sake of the patient’s psychological well being rather than for diagnostic reasons.

Penny: It’s not for me, it is not because I am unsure of what I am saying. It is for the patient, I don’t want her to think that this girl has just come along and scanned me and said my baby is abnormal. She has not got anyone else in to confirm it, there are no tests to be done, she is just going to take me away get this baby aborted on this woman’s say so. I think it helps them to know that something else has been, that you know, especially in the case where you are looking at foetal hearts, and they are 6 or 7 weeks.

In this statement Penny is acknowledging that the pregnancy could be ended because of her diagnosis. It is also important to note that in this critical decision making and judgement process the sonographer calls on another sonographer for support not a medical practitioner. When this is considered in reference to the discussion in Chapter 1 regarding the extended role of the sonographer it can be seen that the sonographer envisages acting in a truly autonomous manner.

To confirm that the intervention of a peer is not vital the researcher asks Penny what would happen if a peer was not present and the following response is given:

Penny: If a peer isn’t available? And you are on your own? Well, you go with your own decision, that is what has happened in the past when other people have not been around to do it, not just for me you know other staff in the same situation. It is not

part of the protocol that you have to have it confirmed by somebody else

Researcher: *Yes?*

Penny: *It is just something that I like to do actually not for me, but for the sake of the patients, like I said really.*

During the second round of interviews the issue of peer involvement was less prominent. Hannah stresses that the obstetrician in the case may have a say in the diagnosis. Here Hannah is explaining that if she were uncertain about her diagnosis she would refer the patient to a specialist:

Hannah *If I was telling them I thought that there was quite a high chance of there being something wrong I would explain that to them and then explain because I'm not that certain. Then we would go for a more specialist opinion.*

And later on:

Hannah *You are not on your own. You are only a middle person. There are other people who are going to be dealing with that person, who will give them more information. There are other scenarios aren't there? The other scenarios are going to be which is I think is why you temper what you say. You are only giving half the story really because something else is going to happen. They are going to have another test. You are branching out again then and also the decision making goes over to the parents doesn't it? The amount of information being given by you and by their clinician. And they are able to decide what to do next.*

In this extract the patient is being referred to a superior rather than a peer, this can be considered to be a deferral of the decision rather than peer-aided judgement.

During her interview Susan mentions, unprompted, that there may be a role for a peer giving a second opinion. This is seen in the following extract:

Researcher: What I am particularly interested in, during this interview is what you do with the patient in terms of talking to the patient. What are some of the options that you have got? What are you going to communicate to the patient?

Susan Just about the heart. If I think that there is a problem with the heart I would, look at the rest of the foetus and exclude other problems. I would still go back and have another good look at the soft markers that would give me subtle signs, certain chromosomal abnormalities have heart defects. So I would go and look at the hands slightly more in detail, or the face. If I can't see anything then I will be honest, I am honest with the patient and say I am not getting the view that I usually get of the heart, and I would like a second opinion. But I would lay the groundwork to the patient, and say there may be a problem. I won't say for definite that there is a problem to the patient. Because the way we work in the department we don't always have a follow up on the same day, so I would not want them to go away for a long time, thinking everything is abnormal. But I want them to go away thinking yes there is a chance, so that by the time they come back, if there is a problem they are, partially prepared.

It seems from the observations of sonographers and the evidence gained in both rounds of interviews that peer-aided judgement does play a part in ultrasound practice. Peers are used to help with judgements, usually to give their opinion regarding the images being examined. They are also used to confirm the interpretation already made in order to

reassure the patient (rather than the sonographer). Finally specialist assistance is sometimes called on in the form of a medical opinion. This cannot be classed as a peer-aided judgement or decision as the word “peer” would seem to imply that the two participants are of the same status - this is not the case with regards to the sonographer and the medical practitioner within the medical hierarchy. Since medical practitioners were not interviewed we can make no assertions about the mode of cognition they employed, though it is likely to be predominantly intuitive.

Neither during the observations or the interviews were legal issues considered with regard to seeking a second opinion. This is interesting because, as already stated, the role of the sonographer is increasing and with an increase in medical litigation. It is surprising that sonographers are not protecting themselves legally by using more peer-aided judgement and decision making.

10.1.3 Systems-aided decision making

Systems-aided decision making as been defined by Dowie (1994) includes:

“Almost any formal and explicit aid to reasoning. Systems aids range all the way from sophisticated systems accessed by computer (embracing both ‘data based scoring systems’ and knowledge based algorithms and ‘expert systems’) to drawing on simple analytical techniques such as, for example, listing logical possibilities on the back of an envelope.”

This approach to decision making is discussed in Chapter 2 together with various kinds of decision support systems. Decision analysis - the main research tool used in this study

- can be used as one type of decision aid. None of the people interviewed in this study used decision analysis in their clinical practice. However one of the sonographers interviewed stated that she had come across decision analysis as part of a management course that she had attended.

Another form of “Systems-aided decision making” is the algorithm. This is a logical set of instructions that leads the practitioner to a decision, although it should be noted it is not their decision, it is the decision of the person that wrote the algorithm. Dowie (1993) sees these algorithms or flow charts as the form of decision aid “that have proved to be most acceptable to clinicians”. They can be used as a method to make decisions remotely and this form of decision making has accordingly been much used in developing countries. Algorithms are typically drawn up by medical practitioners and used by non-medically qualified primary health care workers. By using algorithms the primary health care worker can mimic decisions that are traditionally made by medical practitioners. It could, however, be argued in using algorithms the primary health care worker is not making decisions at all - the person who constructed the algorithm is making the decisions.

The position of the sonographer is somewhat analogous to the primary health care worker in developing countries. The sonographer’s role involves making judgements and decisions that are traditionally made by radiologists or obstetricians. The term algorithm is very rarely used by those involved in sonography but in an earlier part of this research during observation of sonographers they were seen to be operating under multiple protocols. Protocols can be considered to be a form of loose algorithm. An

algorithm is a set of instructions and policies that the sonographer must follow. From the observations and interviews it would seem that like algorithms, medical practitioners have formulated the protocols used by sonographers in most cases, in this case by obstetricians and radiologists.

The role of protocols featured heavily in the interviews, particularly in the first round. It can be seen from the notes made during the interview with Gail that they were the first thing considered when she was given the decision making problem:

It is interesting to note that as soon as this question was put Gail raised the issue of policy. Her precise answer was to say 'that depends on the departmental policy'. She wanted to know what the policy was in the department involved in the scenario. Her direct question was not answered but the researcher opened up a discussion about policy.

Gail felt that the worst possible policy for the sonographer was one where the radiologists and /or the obstetricians laid down that the sonographer could give no information to the patient. This could often leave the patient feeling that there was nothing wrong with the developing child. On the other hand patients might sense that there was a problem but their suspicions were not confirmed, leading to anxiety and distress through uncertainty. Many women asked questions about the image and sonographers working under this type of policy would often have to tell half-truths in response. This could often lead to women not knowing what to believe next time she was examined.

Gail went on to outline the policy that is in place in her own department. In her department the partner is allowed into the examination room from the start of the examination and this does seriously change the dynamics of the sonographer/patient relationship according to her. The patient is warned that a full scan will be performed and that at times this will be technically difficult for the sonographer, so that she may well frown. The patient is reassured that this often happens and does not mean that there is a problem with the developing child. In a case

such as the one in the scenario which Gail described as "cut and dried" (no uncertainty) the patient would be told about the problem at once. If the case was less certain a second sonographer would usually be brought in to check the findings.

This extract shows the importance of protocols to Gail. From this account there are clearly some ultrasound departments where the sonographers do not make the decision regarding telling or not telling. In some departments they are not allowed to tell. In these departments the medical practitioner makes the decision via the sonographer.

Protocols were also an important part of Kate's professional practice:

Researcher: *And all patients will be told in exactly the same way?*

Kate: *Well, I don't know. I don't think so, I mean there is no protocol of how you go about telling the patient, I think you just, as human beings, just on an individual case decide how you are going to tell them, how you know, break the news. I can't put it into a structure.*

Later in the interview Kate once more considers the issue of how sonographers relate to obstetricians in the case of detecting an abnormality – in this case a choroid plexus cysts:

Researcher: *There's no problem with that.*

Kate: *If you feel they can't take it in at the time what you have told and shown them. You would actually have to make sure they understand. I don't know, you have only so much time and you have the pressure of the other patients. But with the abnormality you can't tell the patient, unless it is something that you know you have been told not to because of the protocol of the department.*

Like we have been told by the obstetrician not to tell them about choroid plexus cysts if they are below 5cm or with hydronephrosis.

The use of protocols was not so evident in the second round of interviews as the first round. This may be either because the two participants were senior sonographers or because the task in the structured sessions was one that did not require participants to follow protocols. The issue of protocols was raised in the interview with Susan:

Researcher: *One aspect that you have not brought up, and it's been a very strong feature of other people's views, is the use of protocols, - what they can tell and can't tell. That does not seem to be a function of your thinking.*

Susan: *I think it is because, I am more of a senior sonographer in the department. I feel that the protocol is there to provide guidelines, but there is leeway in that guideline.*

Researcher: *Right, so you don't feel that you are constrained.*

Susan: *Yes, I am within a constraint, yes, but my constraint is not that narrow. And I feel that when you are newly qualified you feel the constraints more and when you are actually working one to one with the obstetricians at the moment they feel that you have got the experience and therefore they can rely on your judgement. We have protocols, but our protocols are not so narrow.*

So, Susan looks at protocols in a different way to Kate and Carol above. Susan sees the protocols as guidelines. If this is the case then for Susan protocols are less like algorithms to be followed, less a form of systems-aided decision making, more a version of a paper based peer-aid.

In the interview with Hannah she stated she writes the protocols for use in her department with the approval of the medical practitioners:

Researcher: *OK I want to talk to you about protocols that you work to. You said that you do tell the patient if there is abnormality. And you did say at that point if they ask there is no decision I will always tell. How much of your work in this kind of situation is decision making and how much is following protocol?*

Hannah: *You are tied by protocols but I am in the fortunate position of not ever having a situation where you are not allowed to tell the patient anything. If I were I would find that very difficult. Most of the obstetricians that I have ever worked with have not minded you saying something. Maybe some of the obstetricians that I work with in my present post are bit more restricting but I have to say that because I am so used to really doing my own thing I do it! Because I have been a superintendent for a long time I am the one that normally writes the protocol anyway. Although the protocols have to have the approval of the obstetricians in fact since I started I have been rewriting the protocols just updating them. One of the aspects of that has been what action to take in certain circumstances. So those circumstances being if you see a certain thing what you have to do about it. Now one of the most controversial things at the moment is the question of soft chromosome markers and what action that we take. I have been trying for at least six months to get the obstetricians agreement on what they would like us to do. This ties in with biochemical screen tests where they are given a risk factor. So that is where you are actually giving a number with the screening which says you have a 1 in 150 chance of this being Downs. I think that that is the cut off*

for deciding for going onto an amniocentesis or not. In ultrasound you have a list of things that you might see and you have to decide whether to take action or no action.

Researcher: *What would the action be*

Hannah *It depends on what you had seen. Say that you had seen a dilated cerebral ventricle 10mm is the upper limit of normal suppose the patient is 10 or 11 mm. My suggestion to that scenario is to repeat the examination in two weeks to see whether it has increased or is normal. That is an example.*

Researcher: *That's the cut off point*

Hannah: *Yes. Then two weeks later if it is normal then fine. Forget it, but if its increased you have to make another decision. How much it has increased in size. I have a list of things like this. I'm told that at the last meeting that they (obstetricians) had - after an hour they still had not come to a joint decision. Because they all had different opinions.*

Researcher: *Is it the obstetricians that get most involved in protocols?*

Hannah: *Yes. In obstetrics it has to be because the whole management of the patient is based on it and the ultimate decision is theirs. That's why a lot of decisions that we make are going to be based on what the obstetricians feels and thinks they are going to do about it. Because the ultimate decision is his along with the patients.*

Researcher: *So the radiologists do not get too involved.*

Hannah *Well I suppose it depends on the department. In our department they do not get involved at all because they don't do any obstetrics. You do get departments where you get a radiologist who is heavily*

involved in obstetrics. Everywhere is so different. In some departments if you see an abnormality you bring it back for the radiologist to scan. If they confirm it then they tell the patient. You do not tell the patient much at all because it has to be confirmed by the radiologist.

Researcher: *Difficult?*

Hannah: *Yes.*

It became evident during the interviews that the sonographers seemed to be imposing their own rules to follow. These could almost be considered “implicit cognitive protocols”. These cannot be considered strictly a form of systems-aided decision because if Dowie’s definition is used the system must be explicit and implicit cognitive protocols or heuristics are not. In the final structured interview this issue was raised with Hannah.

Researcher: *Do you think sonographers sometimes impose their own protocols on what they do and tell the patient.*

Hannah *Yes that’s bound to happen to some extent because people are individuals. I do think that you do need a protocol because most people need a guideline. In fact I call protocols guidelines. Not strict protocols. Also because I think you need to be doing something similar. Patients from the community talk. That can cause a problem in itself in what one person is told compared to what another person is told. You have to gain the trust of your patient so you have to have some guidelines so that you do something similar. In order to gain that trust.*

Researcher: *I have called it cognitive protocols. I think I saw an example in your decision where it was not tell- they ask no decision I’ll*

always tell. There would be no thought of doing the radiographer trick of "I'm only the sonographer" or "the pictures are still wet".

Hannah: Well I would be very inclined to do that in general abdominal scanning I do use that trick - but not in obstetrics. And it's all to do with gaining the trust of your patient. Because particularly in obstetrics they know that you know. Well in general they know that you know half of the time. They know that you know and you can't get round that. And you can completely lose their trust once you have uttered those words - yes every thing is fine. When it just is not. That's just my view. I don't think you can say it is fine when it is not. That is an absolute lie and once they find out it's not, they will never trust you again.

Researcher: So it is a rule that you have made for yourself.

Hannah Yes something that has crept up on me over the years I think. The role of the sonographers has changed and it has changed a lot. In the beginning when you were not allowed to tell and you weren't practised in telling and you could not deal with the situation. But with experience and you do get used to dealing with the situation then it is different. But if you are a student and you have not got used to dealing situation um then you are going to procrastinate more I think. I am very careful what I say. Very careful

It would seem from the interviews that systems-aided decision making is used to a limited extent. This is in the form of protocols, which are either produced by senior sonographers or by medical practitioners. Where formal protocols are not in place it may be that sonographers formulate and impose their own "cognitive protocols", "implicit heuristics" or "informal practice policies".

Although the participants did not use decision analysis, after exposure to it during the interviews, its relationship to protocols was explored with them. There was some difference of opinion regarding the use of decision analysis to formulate policy, as distinct from making “bedside” decisions in individual cases. In the following extract from the notes made during Gail’s interview it can be seen that she feels that decision analysis could have a part to play in the formulation of policy:

She thought that the process could be used to develop protocols for the department that could be a help to newly qualified members of staff. The technique could also be used with inexperienced sonographers to help build their confidence. Newly qualified members of staff found protocols useful but they should have the freedom to make decisions within them. Gail also thought that the process of structuring a tree could be used to aid both group and self-reflection. It highlighted decisions that needed to be made, but were often made covertly rather than explicitly.

Conversely when Hannah was asked if decision analysis could be used for the formulation of policy, she stated:

Hannah *No not for a protocol because they are quite factual. I would imagine using this sort of thing where there is doubt. Writing a protocol is quite a factual thing.*

This statement was made after exposure to decision analysis. It is interesting to note that even after using this overtly analytical method with its focus on values essential to decisions as well as facts, Hannah’s objection was that it was not factual enough! Hannah did not feel that it was “factual” enough to formulate protocols.

10.2 Conclusion

Hammond's cognitive continuum provided a useful framework to discuss the findings of the interviews in terms of how decisions and judgements are made in radiographic practice. From the evidence of the interviews and observational study it is concluded that intuitive judgement is the most prevalent form of decision making in radiographic practice. But there is also a strong element of peer-aided judgement. From the evidence gained during these interviews it seems the use of peers has two functions, one as a decision aid and the other to reassure the patient. These two functions should not be confused when considering decision making and judgement in radiography. There is little evidence of the use of systems-aided judgement except in the weak form of broad protocols.

It should be emphasised that the sonographers interviewed in this study are all experienced. From the work of Benner (1984) it is to be expected that experienced practitioners will tend to use intuition rather than analysis. It would therefore be interesting to repeat the work with a group of sonographers of differing experience to determine if similar methods are used to make decisions and judgements.

Chapter 11

Relationship between judgement and decision making

11.0 Introduction

This chapter is focused on addressing the primary research question: “*What is the relationship between judgements and decisions made in radiography?*” Some insight was gained regarding this question during the observational study and the first round of interviews. The final two in-depth interviews however, provided the most data regarding this question. The method used in these final interviews was discussed in chapter 7. The method of data analysis was also outlined in chapter 7. After analysing the data the issue that were chosen for consideration and exploration was that of differentiating between judgements and decisions, the impact of judgements on decisions, and the impact of base rates on judgement and decision making.

11.1 Differentiating between judgements and decisions

During the interviews it became evident that there was confusion between the concepts of decision making and judgement. In some of the first trees drawn by the participants judgements were structured as decisions. A good example of this is seen in the trees drawn by Gail in Appendix 4. In her first tree (Appendix 4 G1 and Figure 10) she structures the judgement of the patient’s intelligence as a decision:

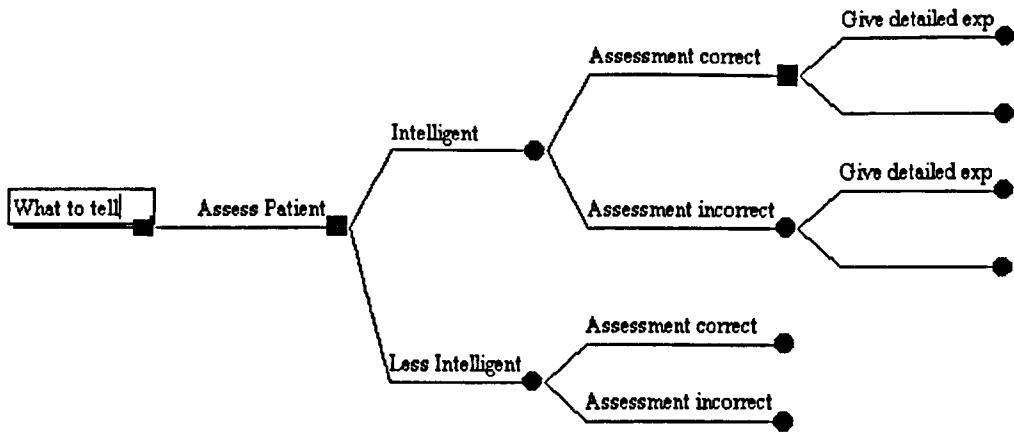
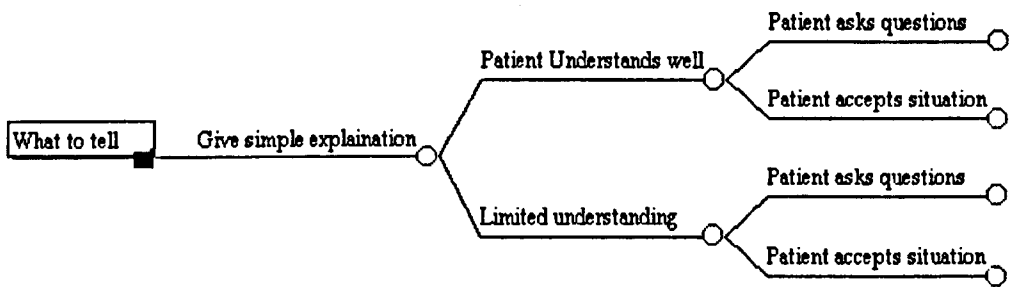


Figure 10 Decision Tree G1

In this tree it can be seen that Gail starts by having the title “What to tell” and a decision node “Assess Patient” a decision node which has branches which have the outcome of Gail’s assessment of the patient follows this. Gail changes the tree in the next tree (Appendix 4 G2 and Figure 11) to the following structure:

Figure 11 Decision tree G2



Here we can see that a decision node is followed by only one branch “Give simple explanation”. If there is only one option then there is no decision. The chance node that follows this decision node is also interesting in that it is a chance event that requires a judgement by the sonographer. The patient may well understand or not have understanding - but the sonographer must judge this.

This lack of a prime decision at the origin of the tree persists until Gail's 6th tree (Appendix 4 G6) where she includes a decision at the origin of the tree. Part of this tree is shown in Figure 12.

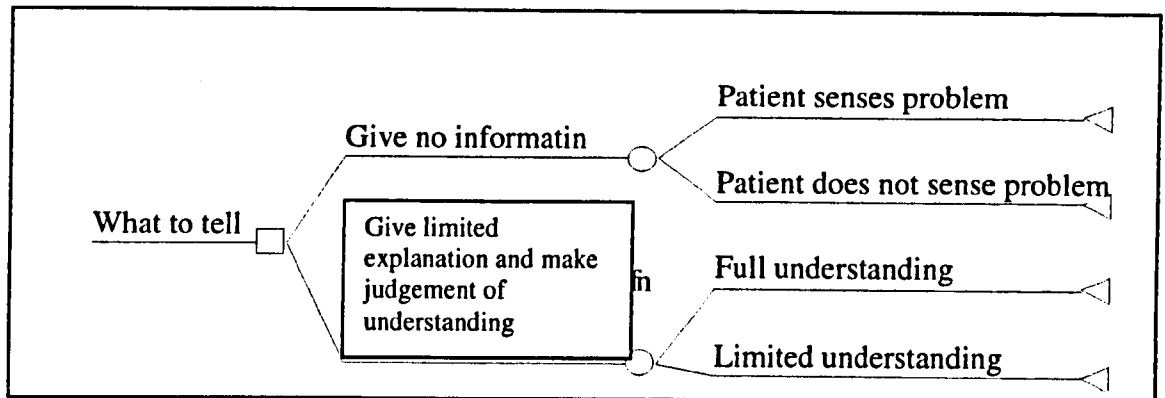


Figure 12 Part of decision tree G6. Shown in full in Appendix 4.

Decision tree G6 represents a substantial development from her previous trees. In this tree the prime decision has been identified - to give or not give information. Gail has also identified that the patient's level of understanding is really a judgement on her part. On this tree it will be seen that the node after "Give simple explanation and make judgement of understanding" is a decision node. This was a mistake which was rectified in Gail's 8th tree G8 (Appendix 4 G8). (Note that from now on we do not intend to comment on "mistakes" in intermediate trees other than those relevant to the topic under discussion).

Another example of this type of confusion between judgements and decisions is seen in the tree developed by Kate. Kate starts by structuring a tree that indicates that she would “tell patient” and follows this by a chance node that is based on her judgement of the patient, as Figure 13.

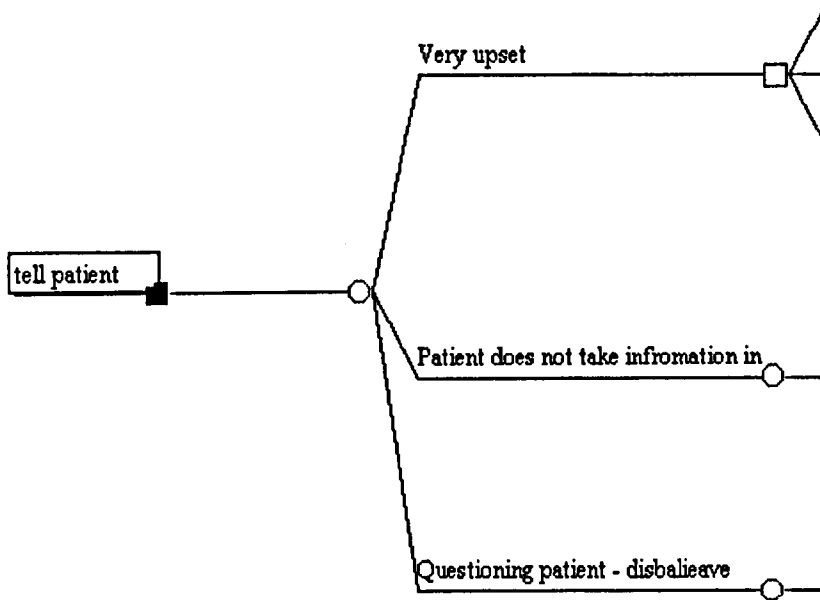


Figure 13 Part of tree K1. Shown in full in Appendix 6 K1

It is not until tree K4 (Appendix) that Kate comes to the conclusion that her prime decision in this case is to give limited information or full information. K4 is shown Figure14.

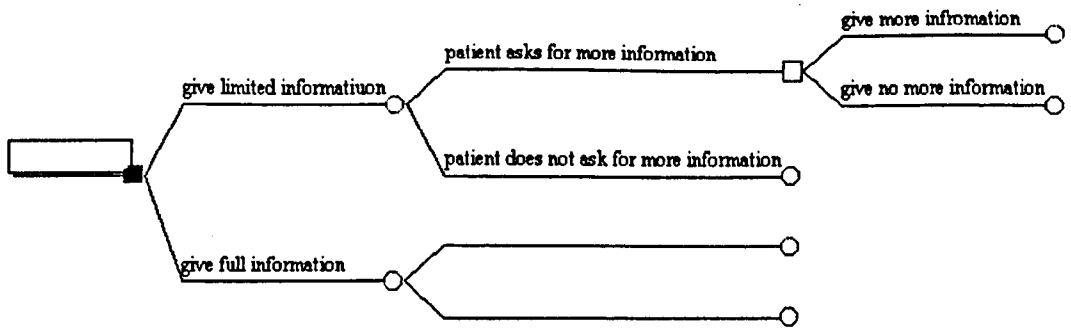


Figure 14 Decision tree K4

Yet another example is seen in Carol's trees. Between tree C1 and C4 (Appendix 3 and Figure 15) Carol has her root decision node followed by branches labelled "abnormality present" and "abnormality not present":

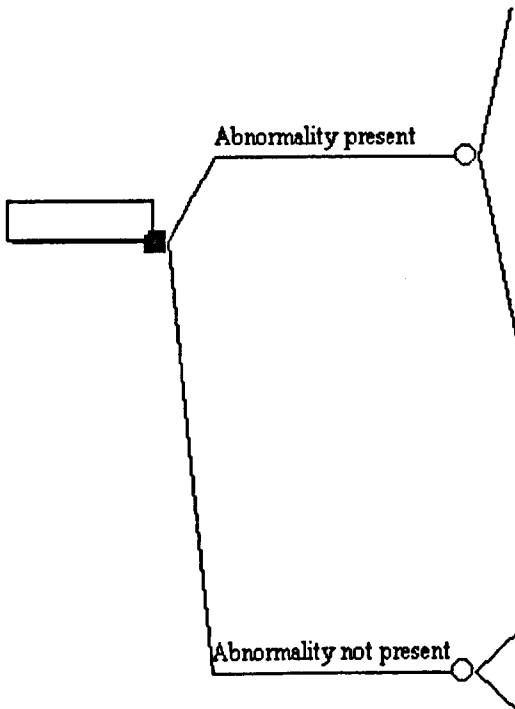


Figure 15 Part of tree C1 shown in full in Appendix 3.

In this tree the abnormality present or not present is a chance event which requires judgement from the sonographer not a decision.

From this evidence, distinguishing between judgements and decisions was one of the hardest things to teach. In most cases the most effective way of doing this proved to be to let participants get to a quite advanced stage of structuring. By this stage it was found that the participant had learnt enough to discover the difference between decisions and judgements.

In the final four interview sessions the concepts of judgement and decisions were introduced into the road-crossing example. The researcher explained the difference between judging the chance of being run over and making the decision to cross. This did help, but when practitioners came to drawing their own tree, there was still some confusion, showing how this fundamental normative principle is alien to most practitioners unaccustomed to this analytical approach. However practitioners did eventually seem to cope, although it did on occasion involve radical restructuring of the decision trees.

11.2 The impact of judgements on decisions

During the final round of interviews sonographers were asked to undertake not one but two tasks: a judgement and then a decision. The judgement was to assess the chance there was an abnormality demonstrated on a set of two images and the decision was whether to tell the patient about the abnormality. This section of the chapter examines how the sonographers went about these two tasks and establishes the relationship between them.

As with the unstructured sessions the participants invariably asked for further information regarding the scenario. There seemed to be reluctance to assign a probability value to the chance of abnormality being present when they only had the two still images, as in practice the sonographers would be producing their own dynamic images. This type of reluctance is clearly demonstrated in the following extract from the session with Susan after she had been shown the set of images:

Susan: Are they both the same picture?

Researcher: No, it's not the same picture but it is the same case. Same foetus.

Susan: Am I allowed to say I don't like to make decisions on pictures. Because the whole process of the ultrasound is a dynamic scan and especially the heart, a moving structure, and in order to see all the areas carefully you have got to scan around it so, and the appearances vary according to... although the basic appearance is the same, it can look different at different gestations, so I want to know what gestation that is.

Researcher: Right, this is a 18 week scan, and I accept completely what you say that normally you would be looking much more closely and it would be a dynamic scan.

Susan: That's right.

Researcher: That being said, lets pretend if you like that this is as much diagnostic information as you can get out of the scan. So I know that is probably relatively very low compared to the information that you would get out of a dynamic scan, but let's say that that is as much as you can get.

Susan: *Well, it's a cross section of the chest because I can see a cross section of the aorta there, so I think it is supposed to represent a four chamber view of the heart, and there I can not see a four chamber view of the heart there.*

Researcher: *So you won't get as much information off this as a dynamic scan, but we have accepted that this is really as much information as you can get from a scan, be it dynamic or just pictures.*

It can be seen from the above extract that the researcher phrased responses in such a way to relate the scenario to the participant's clinical practice. The participant was asked to imagine that this was the only information that they could get from a dynamic scan.

The scenario introduced a level of uncertainty into the decision making process that was not present in the previous round of interviews and the inclusion of the set of images forced the participants to make judgements. Unprompted Susan compares the judgement that she is being asked to make in this case to other easier judgements that she has to make in clinical practice:

Susan: *And the other thing I would consider is, if there is 100% chance like if the foetus is dead. I find it easier to make the judgement of whether to tell or not because when it is subtle, like with the heart or choroid plexis, the decision is very difficult because I am not exactly sure what the problem is. And in the clinical setting you don't have the time to explain, so the decisions are based on whether there is a follow up the same day.*

In this extract Susan is saying that in more unequivocal cases she finds it easier to make decisions. She is also adding extra environmental considerations of the type seen during

the unstructured interviews. The extract also demonstrates that there is a direct link between the judgement and the decision. She is stating that if she is 100% certain that there is an abnormality she will make the decision to tell the patient. Since it can be assumed that if she judged that there was a 0% chance that an abnormality is present she would not tell the patient there was an abnormality demonstrated, there is consequently a cross over value or threshold probability between 0 and 100. Later in the interview this cross over point was pursued - the point at which the level of chance being assigned would trigger the decision to tell the patient.

Once Susan had made her unease about the scenario overt and she had considered environmental issues she began the process of assessing the probability that an abnormality was demonstrated on the images. This process is illustrated in the following extract:

Susan: Well I think we are aiming at a four-chamber view here, and basically this is not a four-chamber view in this section. Because I can see the ventricular septum, but I can not see the atrial septum, you can't always see it unless you get a proper four-chamber view, but it doesn't look normal to me.

Researcher: It doesn't look normal?

Susan No

Researcher: There is a chance that this is abnormal?

Susan There is a chance, a very good chance that it is abnormal, because they have probably looked at it and then chosen that image.

This is the point at which Susan makes her first assessment of chance. It can be seen that rather than use a numerical value to express her estimate of chance she uses words - in this case "a very good chance". Even when the researcher asks Susan again to state how certain she is that the images demonstrate an abnormality she uses words:

Researcher: OK, so there is a chance that this is abnormal. The question is, if you had these images what kind of level of certainty, how certain are you that there is an abnormality there?

Susan: I am very certain that there is an abnormality because there is indeed the normal view we see, but I am not very certain what exactly the abnormality is.

Here the words used to describe her level of certainty have changed from "very good chance" to "very certain". These two responses came within a few seconds of each other and serve to demonstrate the possible lack of consistency inherent in using words to express levels of certainty though it is also possible that her level of confidence in her assessment changed in that short period.

At this point the researcher prompts Susan to use numbers to indicate chance:

Researcher: So you are very certain. So what would that be in terms of chance, from 0% to 100%, where would you put it?

Susan: More than 50%, more than 50% chance that it is abnormal. I would say that it is about 90%, if there definitely is no atria septum I would say nearly 100% shall we say.

Researcher: *How nearly?*

Susan: *100%*

Researcher: *So there is no chance whatsoever that this is normal?*

Susan: *Based on what we have seen that there is no atria or ventricular septum, yes 100%.*

Researcher: *Right, so 100% that it is abnormal.*

(at this point Susan re-examined the two images)

Susan: *Oh sorry, that must be another view, of the same thing.*

Researcher: *It is the same patient yes.*

Susan: *Oh right, maybe its a ventricular, so it could be a..... I would still say it is abnormal, but I would say about 90 or 85% that there is a problem.*

Researcher: *Right OK, 85 - 90% chance.*

It is evident from this extract that Susan finds the task of numerical assigning values for her judgement of abnormality difficult. She stated very clearly at the end of the interview that she would not normally think in numbers and had found this a major challenge.

Later in the interview Susan was asked to draw her decision tree for this situation. When she got to this point she re-examined the ultrasound images and also changed her values for the chance that there was an abnormality present:

Researcher: *So this part of the decision tree, but we know that other things come into this. Let's try and put some numbers in here, because I think we have already thought about numbers.*

Susan: *The more I am looking at this I didn't realise that it was the same patient, so when you ask me what chance it was I am not so clear, it looks abnormal but..... so do you want me to tell you a percentage?*

Researcher: *Yes...*

Susan: *I was looking at that, it looks abnormal and I think there is, I think I would say about 75 or 80%. I would still say 80% it just doesn't look right, but here it looks as if it is completely missing this ventricular septum, but I think I may have a better view here, but it still doesn't look right.*

As pointed out in the previous chapter the decision-structuring phase of decision analysis seems to have made Susan reconsider her probability judgements. An important benefit of the decision analysis approach is that it makes practitioners reflect on the judgements and decisions that they have made.

Susan's finished decision tree is shown in tree S4 in Appendix 7 and Figure 23. It is also shown below:

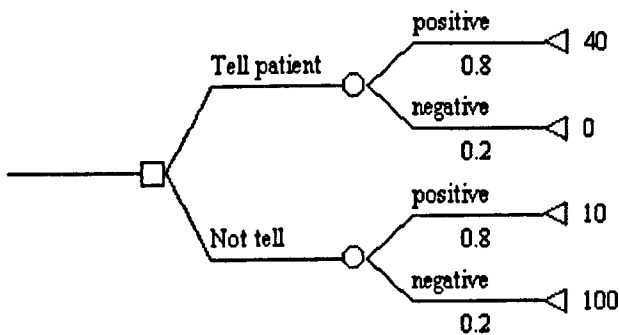


Figure. 23 Tree S4

The utilities shown on this tree were elicited from Susan during the interview. She gave the following utilities:

Tell patient abnormality is present and one is present (TP) $U = 40$

Tell patient abnormality is present and there is no abnormality (FP) $U = 0$

Do not tell patient there is an abnormality and there is one present (FN) $U = 10$

Do not tell patient there is an abnormality and there is no (TN) $U = 100$

The expected utilities were calculated as shown in Figure 24.

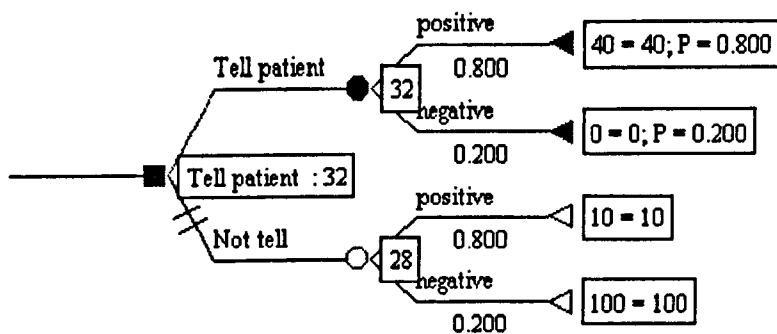


Figure 24 Susan's decision tree with expected utility values calculated

It can be seen that the tree is relatively simple and that the EU for telling the patient of (32) is higher than for not telling (28) and agrees with Susan's intuitive decision for this scenario.

When Susan had finished her decision tree she was asked about how the judgement regarding the image had influenced the decision that she had made. This was achieved

by asking her to consider possible cross over points, which would change her decision, whether or not to tell the patient.

Researcher: *On this image, you said there was a 80% chance that there is an abnormality. Where is the cross-over point for you? I mean if there was let's say a 3% chance that it looked abnormal would you tell the patient then?*

Susan: *I would say, I would say that it doesn't look right to me.*

Researcher: *At 3%?*

Susan: *Because the patient has got to,..... I wouldn't say there was an abnormality, I would say I am not getting the view I need. So maybe the choice of words would be different.*

Susan states that the patient would be told something even if she judged the chance of abnormality being present was only 3%. What Susan has changed here is the nature of the task that she was asked to do. Rather than simply say I would tell the patient if there were only a 1% chance of abnormality she is saying that she would make the decision to change what she tells the patient. A later extract gives further insight into Susan's feelings regarding her own clinical judgement:

Researcher: *At what point do you call back the patient for a follow up?*

Susan: *Anything, apart from.....if I am, nothing less than 100%*

Researcher: *Nothing less than 100%. so even if there was a 1% chance,*

Susan: *In my mind I would call them back. yes, even 1%*

Here Susan is saying that she has to be 100% certain that there is no abnormality present before she can report it as being so and not ask the patient to go to follow up. Susan implies stating that when she reports a negative result she is absolutely confident in her diagnosis.

To confirm that Susan was sure that she would tell patients something even if she considered that there was only a 1% chance that there was an abnormality the researcher further questioned her on this issue by giving her a range of chance values to comment on:

Researcher: *I want to come back to the question about the level of certainty that you would tell the patient. If you were 40% certain there was an abnormality would you tell the patient?*

Susan: *40% that there is an abnormality, I would tell the patient.*

Researcher: *You would tell the patient at 40%*

Susan: *Yes, I would tell the patient there may be a problem.*

Researcher: *Right, OK. Do you ever use numbers, do you ever say I think there is a 50-50 chance or maybe a 40% chance.*

Susan: *No, because we do not have the up to date research on it, but I would be the only time would be in amniocentesis, where we keep, we do an audit, and we have national figures. So I don't know everything about how, based on this, what are the chances of the baby surviving. So this baby needs to*

be referred on to a specialist centre. So I would not be able to give them a chance.

Researcher: *OK, so 40% you are going to tell them? What about a 20% chance?*

Susan: *20%? Yes, I would tell them. 10% maybe not,*

Researches: *15%?*

Susan: *No, I think I would leave it.*

Researcher: *So about 20% is the cross over value.*

Susan: *Yes. It is very difficult, I have never thought about that.*

At this point in the interview the decision tree was redrawn using the 20% value rather than the 80%. It was found that this second tree using a value of 20% gave an expected utility that would advise not telling the patient there was an abnormality. This is shown Appendix 7 tree S6 and Figure 26.

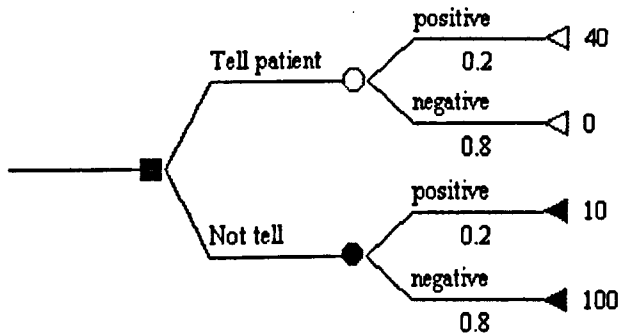


Figure 26 Decision tree S6

The expected utilities were then calculated and are shown in tree S7 in Appendix 7 and in Figure 27.

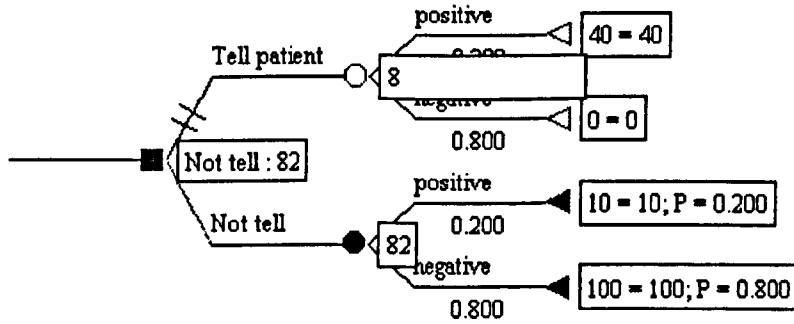


Figure 27 expected utility values calculated on S7

It can be seen from this tree that when the sonographer judges that there is a 20% chance that there is an abnormality present the decision analysis indicates that the patient should not be told (EU = 82). If the cross over value from the decision analysis and the stated value from the sonographer had been the same i.e. 20% it would be expected that the expected utilities for tell and not tell would be identical. They are not.

By determining the probability values as variables (shown in S8 and Figure 28) rather than absolute values the software could undertake a sensitivity analysis on the data.

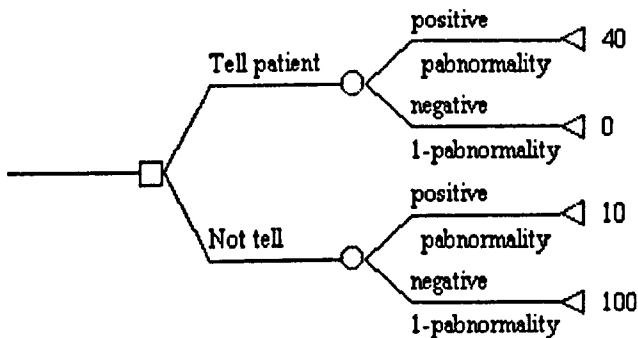


Figure 28 Tree S8

The sensitivity analysis was carried out using the software and it can be seen from the graph in Figure 29 below that for the utility values given by the sonographer the cross over value is $p = 0.769$. The decision analysis would suggest that when the sonographer judges that there is a 0.769 (76.9%) chance that an abnormality is demonstrated the sonographer should tell the patient there is an abnormality. This calculated value is in contrast to the sonographers stated value of 0.2 or 20%.

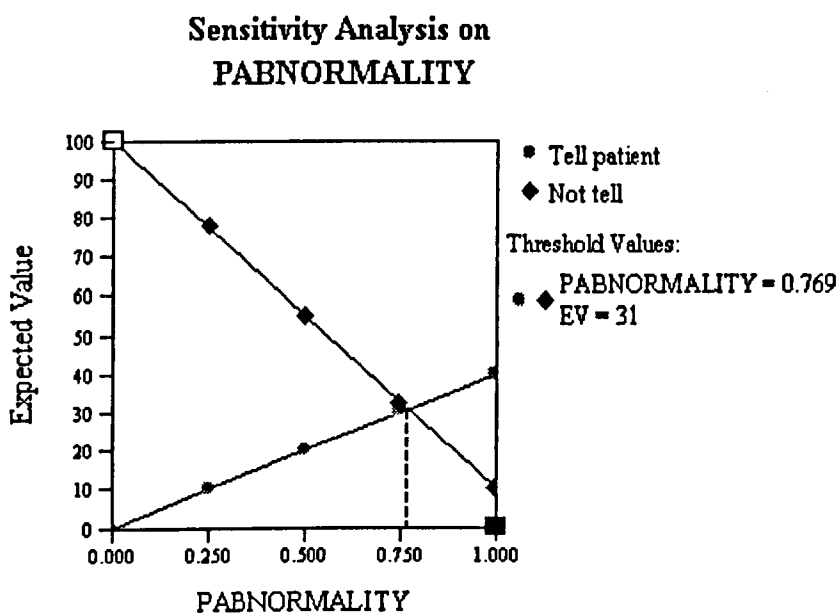


Figure 29 Results of sensitivity analysis undertaken on Tree S8

In her final interview Hannah was questioned about the same issues as Susan. She was more positive in her answers. This may have been because she is a very experienced ultrasound department manager or because she had been briefly exposed to decision analysis in the past, when undertaking a management course. In the first part of the interview she was asked to estimate the chance that an abnormality is present in the two images:

Researcher: So what do you think is the likelihood there is an abnormality is shown on these images?

Hannah: Yes I think that there probably is.

Researcher: I want you to be thinking about what chance is there that there is an abnormality?

Hannah: Percentage wise?

Researcher: Yes

Hannah: It's got to be fairly high if I'm actually thinking that there is an abnormality it doesn't look right about perhaps 70%.

Researcher: 70% chance

Hannah: Yes

Researcher: Do you usually work in those terms - percentages

Hannah: Well normally no, you would not work like this at all. This is an unusual situation. You would not have just one frozen section like this you would have real time. This could be virtually anything - just frozen sections like that.

Hannah uses numbers to express estimates of chance more readily and confidently than Susan, even though she says she would not normally use numbers in this way in clinical practice. Hannah did not change her estimate of 70% throughout the interview session. Later in the session Hannah was asked if she ever had to make decisions when there is uncertainty. From her response it is clear that she is happier to operate when there is no uncertainty, but realises that this is not always the case:

Researcher: *Right on this bit you said that there is a 70% chance of abnormality. When you scan are you ever in situations of uncertainty?*

Hannah: *Quite often yes. Often for definite reasons. It might be due to the patient not being a very good model for ultrasound. They may be fat and you simply not getting a good image for whatever reason, foetal moving or foetal position. And you would never base an absolute decision unless you were sure. If I was looking for a foetal abnormality and I was going to tell the patient that they had a problem and report on it then I would want to be you know 100% sure not 70% sure. So obviously I would do other things to make me more certain of that.*

Researcher: *And can you always do that?*

Hannah: *Not always, no if it's the fact that the patient is fat or what ever there is nothing you can do about that. But you know you would want to be as certain as you can be and certainly repeat the examination another day or they would be referred to a more specialist centre if you had any doubt*

Researcher: *So do you think that decisions are only ever based on 100% certainty*

Hannah: *For something as important as this ahhhh well not 100% I don't think anyone can ever be 100% in this sort of situation. But you would certainly have to be a lot higher than what I am saying at 70%*

Whereas Susan felt that she needed 100% certainty regarding her clinical judgement particularly when reporting a negative finding, Hannah seems to be more realistic about the chances regarding certainty.

Researcher: *There are just a few more things that I want to cover. Did you say that if there is a 70% chance that there is an abnormality you would normally mention it?*

Hannah: *Yes*

Researcher: *But at 50/50 you would not - or is that the crossover?*

Hannah: *That is a crossover. I think you try to get away with as much as you can basically. Which is where the not ask comes in*

Researcher: *Right.*

Hannah: *But the second anybody asks is every thing all right then that's it you have to say yes or no there no question there you have to give them an answer and its got to be yes its fine or you can not say yes it is fine when its not. There is a very definite decision there.*

Here Hannah indicates that the decision proactively to tell the patient about the abnormality is made when she estimates there is a 50% chance there is an abnormality present. The decision to give the patient information when asked is made when the chance is put at a much lower level.

Hannah was questioned further about this cross over point and if there was a lower level of certainty where she would not even mention the abnormality on the medical report. This led into a number of questions about the chances that she made incorrect diagnosis in her clinical practice:

Hannah: *There is always going to be that about 2%. That's always going to be there. Simply because there is operator dependency still*

Researcher: *At which point don't you even mention it in the report?*

Hannah: *No you report it as normal because you believe it is. But there is nothing to say that you are right. That probability is always going to be there.*

Researcher: *What probability is there*

Hannah: *That is going to be based on the skill and experience of the operator. As well as the state of the patient.*

Researcher: *Lets take an anomaly scan at 18 weeks what chance is there that you report it as normal and it turns out to be abnormal.*

Hannah: *All factors being right?*

Researcher: *Yes. How often do you get it wrong?*

Hannah: *Yes that's what I'm just thinking about. I mean ... I have made mistakes not that any have had any real dire consequences. I would not believe anyone who said that they hadn't. Um but very few. I would maybe say 1% chance of getting it wrong. It's hard to put a figure on that. I have not from my knowledge made any terrible mistakes.*

Researcher: *You have to accept that there is no such thing as a perfect test.*

Hannah: *That's right. Its very hard to put a figure on. I can only go over my experience. I know its very low. But I have made mistakes. 1 or 2% I suppose.*

Hannah's indicated intuitive cross over was when there was a 50% chance that the abnormality was present, a decision tree was drawn for this value. This is given in Appendix 8 Tree H6.

This tree indicates that Hannah has estimated intuitively her cross over point very close to what the decision analysis using the utilities as input would indicate. A sensitivity analysis was undertaken to establish what the threshold value would be using these utility values. The results of this are shown in the graph in Figure 31.

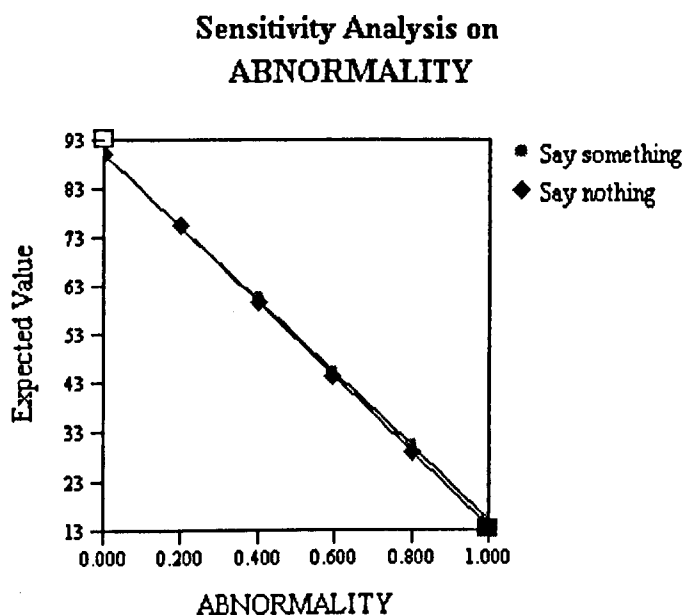


Figure 31 Results of sensitivity analysis undertaken on tree H6

This demonstrated the optimum decision using these utility values is always to tell the patient that there is an abnormality present even when the sonographer judges that there is virtually a 0% chance that there is one.

Both of these decision analyses by Hannah and Susan seem to indicate that the utility values assigned in the interview sessions as would be in the clinical setting. If otherwise Hannah would tell all her patients that abnormalities were present regardless of the judgements that they had made of the images, and Susan only when she was 77% sure that an abnormality was demonstrated.

11.3 The impact of base rates on judgement and decision making

The final issue to be considered is base rates and how these effected the judgement and decision making processes. Base rates are the prevalence of the condition in the relevant population. In the decision task set in the structured sessions the key base rate to consider is the number of pregnant women attending for an 18 week obstetric screening scan where the foetus has cardiac abnormalities.

Susan was questioned regarding this issue:

Researcher: Another thing that I just wanted to talk to you about was base rates for this condition. Just from your experience and knowledge, what is the chance that a foetus at 18 weeks would have a problem with the heart.

Susan: What proportion. National figures are about 4% they say have, although that depends on who has done the research. And the other thing is, our machines are getting better and better.

Although Susan makes a estimate of base rates of 4% compared with an audited base rate of 2% (Dillon and Walton 1997), she does show her lack of understanding of base rates in the final sentence. She indicates the advancing of technology will have an impact on base rates. This is not the case. It will improve the test and from a Bayesian perspective increase its Likelihood Ratios, but will have no impact on the Prior Odds which are the base rate.

Hannah was also asked to make an estimate of the base rate for heart abnormalities:

Researcher: *We talked about abnormality and the chance of there being an abnormality on a scan. On routine 18 week scans what is the chance that they do have abnormalities in the heart. What is the base rate for that?*

Hannah: *I don't have these facts and figures at my fingertips. May be 20%.*

Researcher: *So two in every ten scans that you do demonstrate a heart abnormality?*

Hannah: *Oh no that sounds too high. Maybe, one in a thousand. It's in the literature but I do not have it in my head.*

Hannah made two estimates of the chance of this condition both of which are very far from the audited rate of 2%. As a result Hannah was questioned further about her use of the literature:

Researcher: *OK. It is interesting what you said there. You have not got the literature to hand - have you got the literature at work?*

Hannah: *Yes. The thing with ultrasound is that particularly with obstetrics is you have to keep up with the clinical developments so that the sort of things that I read about and keep up with are clinical appearances really.*

Researcher: *Right*

Hannah: *And new research. That will guide you towards seeing abnormalities better. I have not got a very good memory and I don't retain those sort of figures you know - only ones that I hear quoted a lot such as the miscarriage rate for amniocentesis . But figures for that sort of thing I don't really*

keep in my head. You have to read obviously about clinical appearances that's the main thing

Researcher: *Do you think that kind of base rate for conditions effect you decision making?*

Hannah: *No they certainly won't affect mine. Um although I would have a vague idea of what the chances of this particular abnormality are I'm changing my mind already aren't I because if I'm saying to my self this is something that is very rare then the chances of seeing it are less likely. Um I suppose that does to some extent - even subconsciously affect you decisions. But having said that just the fact that it is so rare doesn't mean to say that you won't find it. It will influence it slightly because you are going to think that it is less likely to be that because its there.*

This response indicates that Hannah does not appreciate the importance of base rates or how they impact on decision making. From a Bayesian perspective the base rate should be playing a major part in her judgement and decision making process. The base rate makes up an important part of Bayes equation and has a massive impact on how certain one can be after a test result has been received. Even an excellent test (or in this case a judge) cannot produce a high predictive value in the presence of low base rate prevalence.

11.4 Conclusion

The final two in-depth interviews provided a number of both interesting and important results. It is clear from these interviews and the rest of the study that decision making and judgement are areas of practice that radiographers and sonographers give very little thought. The study provides evidence to suggest that these practitioners do not fully

understand the difference between a judgement and a decision. Practitioners are also unclear about the relationship between these two aspects of clinical practice. Most of the practitioners encountered during this study placed great emphasis on the importance of published research and data. But evidence from the final round of interviews indicates that they do not realise the impact that simple data such as base rates has on the results of examinations that they are performing.

It is easy to become over critical of radiographers and sonographers when considering these results, but one should not. It is surmised that most health care professionals if subjected to a similar study would produce similar results. Decision making and judgement are at the heart of professional practice but these issues are rarely if ever considered. From the researcher's knowledge of radiographic education there are no radiography or sonography courses that have decision making and judgement as a major component.

It is recognised that radiographers and sonographers are undertaking a difficult professional role that is made even more difficult by the changes in their expected role. This study has demonstrated that decision making and judgement is an important aspect of professional practice that would benefit from further study. The study has also shown that decision analysis provides the researcher with a useful tool for undertaking this kind of study.

Chapter 12

Conclusions

12.0 Introduction

This study was undertaken because of my desire to investigate judgement and decision making within the context of radiography. I set out to establish if decision analysis could be used as a research tool to collect data in the field of professional clinical decision making and judgement. As the study developed it was increasingly focused on one particular area of radiography – the breaking of bad news in ultrasound practice. The research questions that are addressed include:

- 1) *What is the scope and nature of clinical judgements and decisions in radiography?*
- 2) *How are these judgements and decisions made in radiography?*
- 3) *What is the relationship between judgements and decisions made in radiography*
- 4) *Can decision analysis be used as a tool to investigate judgement and decision making within professional practice?*

These questions have been addressed in the course of the study and to a significant but limited extent been answered. It is acknowledged that the study was confined to a narrow area of professional practice. However, by focusing the study in this way the data obtained is of greater depth than if broad areas of professional activity were considered. Although this study is confined to radiography and predominantly sonography it does provide insights into decision making and judgement that may be applicable to other professions and makes a small contribution to our knowledge about decision making and judgement practice both in radiography and other health care professions.

12.1 Contribution to radiography

Radiography is a relatively new profession. It has only been an academic discipline within the university sector for approximately ten years. Compared with other professions there is relatively little research undertaken in radiography. Hence this study has contributed to the knowledge base of radiography. By undertaking this study a greater understanding of the scope and nature of decisions and judgements that take place in radiographic practice has been acquired. The study has also illuminated the particular challenges facing the sonographer when they are faced with breaking bad news to patients, this being one of the most challenging aspects of radiographic practice.

It was found from the observational study that the scope of decision making and judgement across the four hospitals studied was similar. Further studies could be undertaken in other imaging departments to confirm the classifications that are presented in this study. Radiographers' decisions were classified into:

- managerial;
- educational;
- technical;
- communication.

Radiographers judgements were classified as those concerning:

- examination requests;
- patient condition;
- radiographic images.

A better understanding of the nature of decision making and judgement in radiography has been achieved. It was noted that in one of the hospitals studied there was more deferment to medical practitioners, this situation seemed to be due to the lack of autonomy of radiographers in that hospital. The degree of autonomy is an aspect of the culture of the imaging department and this impacts on the nature of decision making by radiographers.

The study confirmed that currently the most prevalent style of decision making within radiography is intuitive, with peer aided decision making also plays an important part. There is little evidence of the use of systems aided judgements and decision making in radiographic practice, other than in the form of policies and protocols which are either radiographically or radiologically driven.

It is clear that sonographers make important decisions that have a massive impact on the health of their patients. Pregnancies are terminated on the diagnosis of sonographers. The observational study established that sonographers' decision making could be classified as:

- patient communication;
- technical;
- diagnostic.

Sonographers' judgement could be classed as concerning

- examination requests;
- patients;
- images.

It is hoped that the classifications of decisions formulated in this study will be helpful to other researchers working in the field.

The key findings in relation to sonography, all of which can best be regraded as having the status of grounded working hypotheses for use in future research, were:

- When making decisions sonographers often state that they use patients values for possible decision outcomes. By using decision analysis it was found that this was not the case. They use their own utilities that are often procedural rather than patient based.
- Sonographers have a high level of confidence in their diagnostic abilities. In the first round of in-depth interviews sonographers found it difficult to acknowledge that their diagnosis could be wrong. In the second round of in-depth interviews both sonographers stated that they would not break bad news unless they were 100% sure of their diagnosis. No test is perfect so logically they would never give this type of news to patients, but both stated that in practice they did. Before the process of decision analysis established that there was a cross-over value below 100%, they were not convinced that this was not the case

- The use of peers in sonography is interesting. From observation it might appear that sonographers use peers to implement a process of peer-aided decision making, but this is often not. In the interviews the sonographers stated that they ask peers in not to verify their diagnosis but to comfort the patient and reassure the patient that the diagnosis is correct.
- A significant aspect of sonographers' decision making highlighted by decision analysis was the production of information by the sonographers themselves when it was missing in the scenario. This information came from their experience of past cases. It would be interesting to undertake further study to establish if this type of provision of information takes place in clinical practice when a patient presents with limited information. Research could also be undertaken to determine the accuracy of "sonographer produced" data.
- It was found that sonographers give little thought to the process of decision making and judgement in their professional practice. During the interviews sonographers placed great emphasis on the data published in empirical studies but could not articulate how this data was used in their professional practice. Sonographers interviewed did not think in a Bayesian manner. The two sonographers who were questioned about base rates could not see the significance or importance of these to their decision making. This is a challenge to health care professional educators who should include decision making and judgement in undergraduate curriculum.

- All decisions in sonography (and general radiography) are based on judgement. Not all judgement lead to decisions. Some decisions are based on more than one judgement. It was found that there was some confusion amongst sonographers regarding the difference between judgements and decisions, which indicates that this aspect of practice is not often considered. The study has demonstrated that sonographers have difficulties in expressing their judgements numerically.
- It is noteworthy that the interviews with the key informants (i.e. the sonography policy makers) highlighted similar issues to those that became evident during the interviews with the sonographers and the patient. There was also evidence of confusion regarding the ownership of utilities and the origin of probabilities. Policy makers face the same decision making and judgement challenges as their practitioner colleagues.
- This project collected data to determine how sonographers make decisions and judgements with regard to breaking bad news. It was found that there was a belief amongst sonographers interviewed that bad news should not be withheld from patients. Their decision trees confirmed this belief. The interview with the patient indicated that damage could be done if sonographers do not give this type of information immediately. The patient interviewed in this study had this type of information withheld from her for only a relatively short period of time, but this had a negative and lasting impact. This aspect of sonography should be further investigated, but from the limited finding of this study, sonographers would be well advised not to withhold bad news from patients even for short periods.

12.2 Contribution to research techniques

A major aim of this study was to investigate the use of decision analysis as a research tool and it is concluded that decision analysis is an extremely useful research tool. The use of an analytical technique to structure phenomenological interviews is novel. In some respects the term phenomenology is problematic in being applied to the research that was undertaken in this study. The reader of Chapter 3 and particularly section 3.2 "Guiding Paradigms" will not, however, find this surprising. It was there acknowledged that both positivist and critical social research influenced the methodology used in this study and although it cannot be considered to be pure phenomenological research using traditional definitions, after much reflection the author decided that phenomenological was the best term to describe the research. Even though the method of data collection was not typically phenomenological in nature the objectives and data collected can best described as by this term. Bogdan and Biklen (1982) state that phenomenological researchers study culture

"From the informants' own point of view, emphasising the subjective aspects of their behaviour. They attempt to understand the meaning of events and interactions to ordinary people in particular situations, trying to gain entry into the conceptional world of their subjects in order to understand how and what meaning they construct around events in their daily lives."
(pp35)

This description fits the research that was undertaken during this study. The researcher did attempt to gain entry into the conceptional world of the participants. Decision analysis was used as a method to gain this entry.

The collection of such unstructured information has usually been collected in phenomenological research by using completely unstructured interview methods. In this research decision analysis was used to collect the data. From the experience of undertaking this research the author concludes that decision analysis can be used to facilitate the collection of this type of information. At first sight it may seem that the use of a structured analytical method to collect unstructured subjective information is paradoxical. The author would however argue that this is not the case and that decision analysis can be a very powerful tool for collecting phenomenological data. More generally one can argue that structured techniques may be a source of major insights into subject's understandings, particularly in so far as it illuminates how they do not construct meanings.

It could be argued that by using decision analysis to collect the data, certain aspects of the participants decision making behaviour such as maximising utility in decision analysis was being taken for granted and being imposed on the participants. This was not the case. Decision analysis was used in these interviews to promote discussion and aid reflection. The process of structuring trees, and adding values promoted discussion not only about these activities, but also about more general aspects of decision making, this is evidenced in the interview extracts contained in this study. It will be seen from the extracts that participants questioned decision analysis and at points stated that they would make decisions differently in practice. So the results of this study in no way support the hypothesis that practitioners make decisions in a decision analytical manner, only that decision analysis can give a very valuable insight into how practitioners make decisions.

Although the technique used to promote reflection and discussion was structured the data collected was, as expected, quite unstructured. The author would acknowledge that the use of decision analysis might have influenced the participants. However, while phenomenological researchers always attempt to acknowledge their biases and preconceptions through a process of bracketing (Minichiello et al 1999) most would acknowledge that there is no such thing as value free research. The impact of decision analysis on the results of this study are acknowledged within this spirit.

The aim of phenomenology is to acquire data regarding peoples lived experiences and perceptions of them. Decision analysis did assist in the collection of data to meet this aim by injecting an analytical stimulant into a predominantly intuitive process. This study found that decision making and judgement in radiography is predominantly intuitive in nature. Practitioners find it difficult to reflect on and analyse this type of decision making, because it is a covert process. By breaking the decision down into structure, chance, and utility the underlying assumptions and perceptions can be exposed.

At a more practical level it has been demonstrated that decision analysis can be introduced to interviewees within the time scale of an interview to a level where they can undertake simple decision analysis. The method of introducing decision analysis to research participants is fully discussed in chapter 7. In this study three different but related techniques of decision analysis were used to collect data:

- During the relatively short (2 hours) interviews with the policy makers it was used in a structured manner with the participants being presented with a decision

tree and they being asked to add values for probabilities and utilities. While they were undertaking this task they were asked to reflect on the process and articulate their thinking. This technique is recommended when the time available for the interview is relatively short.

- During the first round of in-depth interviews decision analysis was used in a completely unstructured fashion. Participants were given a decision making scenario and asked to draw a decision tree for this situation. Participants were free to structure the tree in any manner they wished. The trees that resulted tended to be large and complex. These trees would have little value as decision aids but they were a rich source of data regarding what issues the participants thought were of importance. This technique is recommended when relatively little is known about the decision making situation and a large amount of time (at least one working day) is available for the interview.
- The final way in which decision analysis was used was in a semi-structured judgmental/decision making manner. This method was used in the second round of in-depth interviews. In this type of interview the participants were given a scenario which asked them to make a judgement. They are then asked to undertake a decision analysis based on the judgement they have made. Later in the interview the impact of the judgement on the decision can be explored. This technique is recommended when the researcher is well informed about the decision making situation and there is a relatively large amount of time (at least one working day) available for the interview.

It is concluded that decision analysis is a potentially very useful research tool and can be used to collect in-depth qualitative data about intuitive processes. In summary, this study has demonstrated how decision analysis could be used as a stimulant to “reflective practice”. When practitioners were free to undertake decision analysis they used a system that was dynamic and comparative. Branches on the trees produced were compared and revised and practitioners often radically redrew their trees and changed probability and utility values. This had great benefits in stimulating reflection and led to in-depth consideration of the decision making and judgement process, which in a way which might be thought of as bridging the intuitive-analytical gap.

12.3 End note

At the beginning of this study I stated that one of the greatest factors that influenced me to undertake this study was my involvement with the Open University’s course “D300 Professional Judgement and Decision Making”. This course was written and led by Jack Dowie from the Open University. Jack always ends his introductory texts with a song. So I would like to do likewise by borrowing a song that was found by Jack:

Decision Trees – A Decision Maker’s Lament

*I think I shall never see
A decision complex as that tree –*

*A tree with roots in ancient days
(At least as old as Reverend Bayes);*

*A tree with trunk all gnarled and twisted
With axioms by Savage listed;*

*A tree with branches sprouting branches
And nodes declaring what the chance is;*

*A tree with flowers in the tresses
(Each flower made of blooming guesses);*

*A tree with utilities at its tips
(Values gleaned from puzzled lips);*

*A tree with stems so deeply nested
Intuition’s completely bested;*

*A tree with branches in a tangle
Impenetrable from any angle;*

*A tree that tried to tell us “should”
Although its essence was but “would”;*

*A tree that did decision hold back
‘Til calculation had rolled back.*

*Decisions are reached by fools like me
But it took a consultant to make that tree.*

Michael H. Rothkopf.

Decision Making Questionnaire

This is an introductory questionnaire to assess decision making in professional practice. It is completely confidential. Many thanks for completing this questionnaire. When you have completed it please either return it to Scott Bowman, University College of St Martin, Lancaster, LA1 3JD or alternatively you may leave it in a sealed envelope with your head of department.

Please answer the following questions:

- 1) In your professional practice do you make decisions? YES NO
(Please ring one)

- 2) If the answer to 1 was YES, please give 2 examples of decisions that you make regularly in your professional practice:

I

II

- 3) Do you evaluate the outcomes of the decisions that you make?
 - a) All the time
 - b) The majority of the time
 - c) Sometimes
 - d) Never(Tick one)

- 4) Are you happy about the outcomes of the decisions that you make in your professional practice?
 - a) All the time
 - b) The majority of the time
 - c) Sometimes
 - d) Never(Tick one)

- 5) Have you ever had any training/ information in decision making or judgement?

YES NO
(Please ring one)

- 6) Do you think it would be useful to have some training/information in decision making and judgement?

YES NO
(Please ring one)

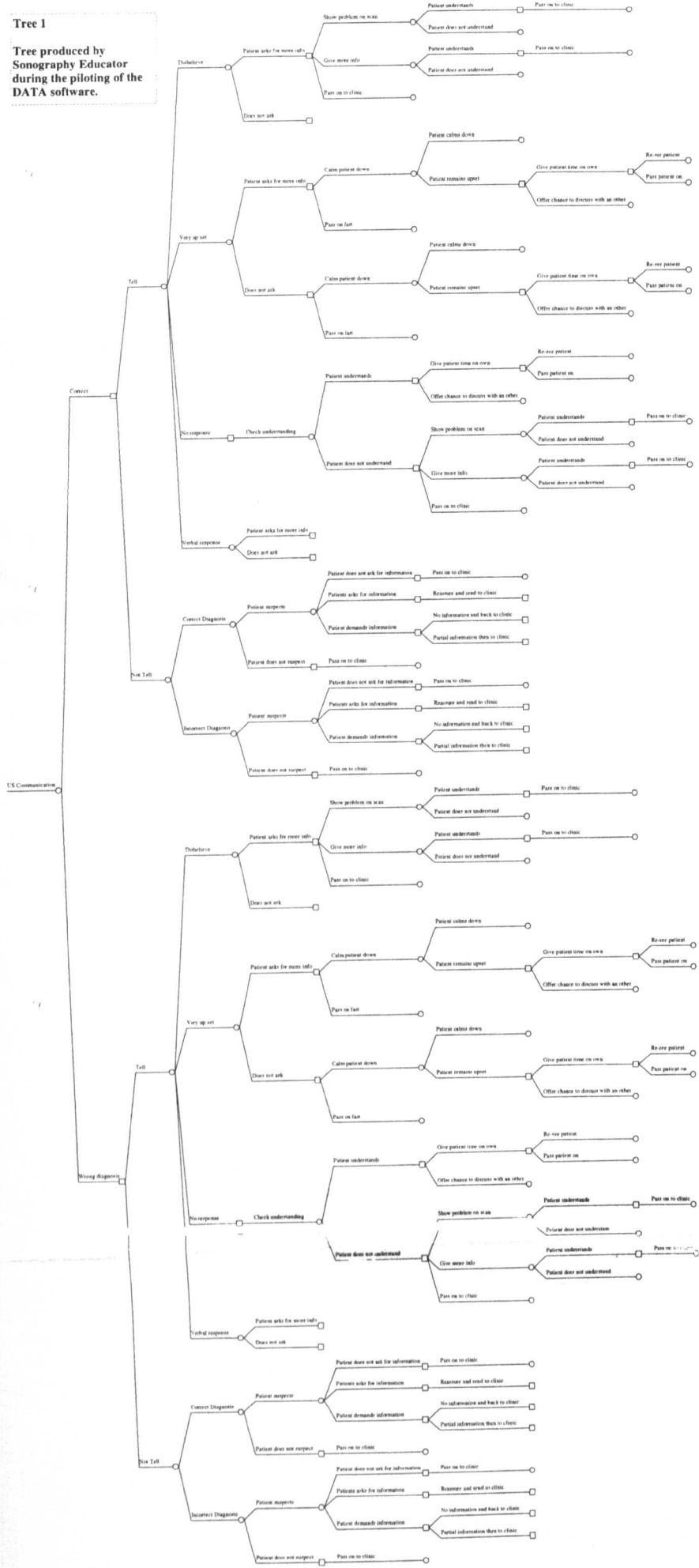


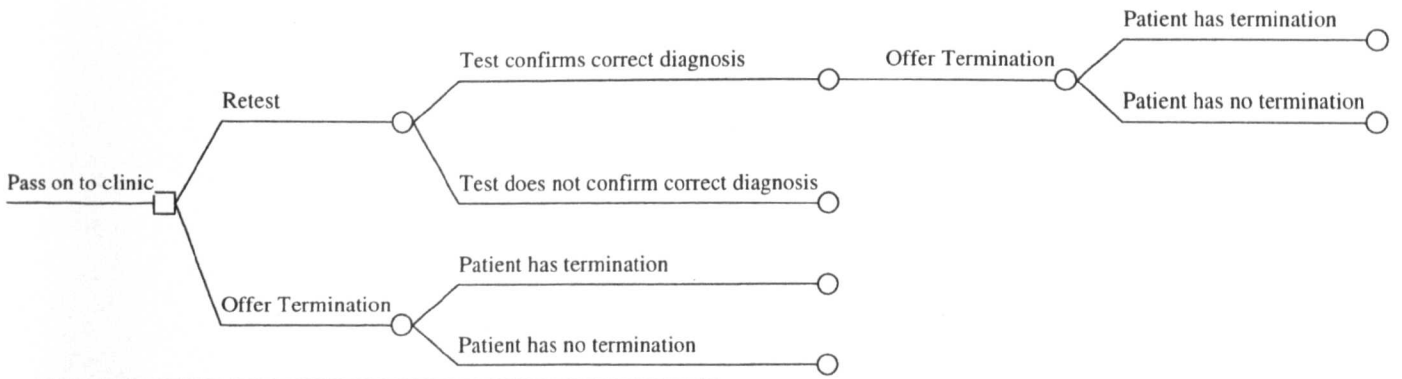
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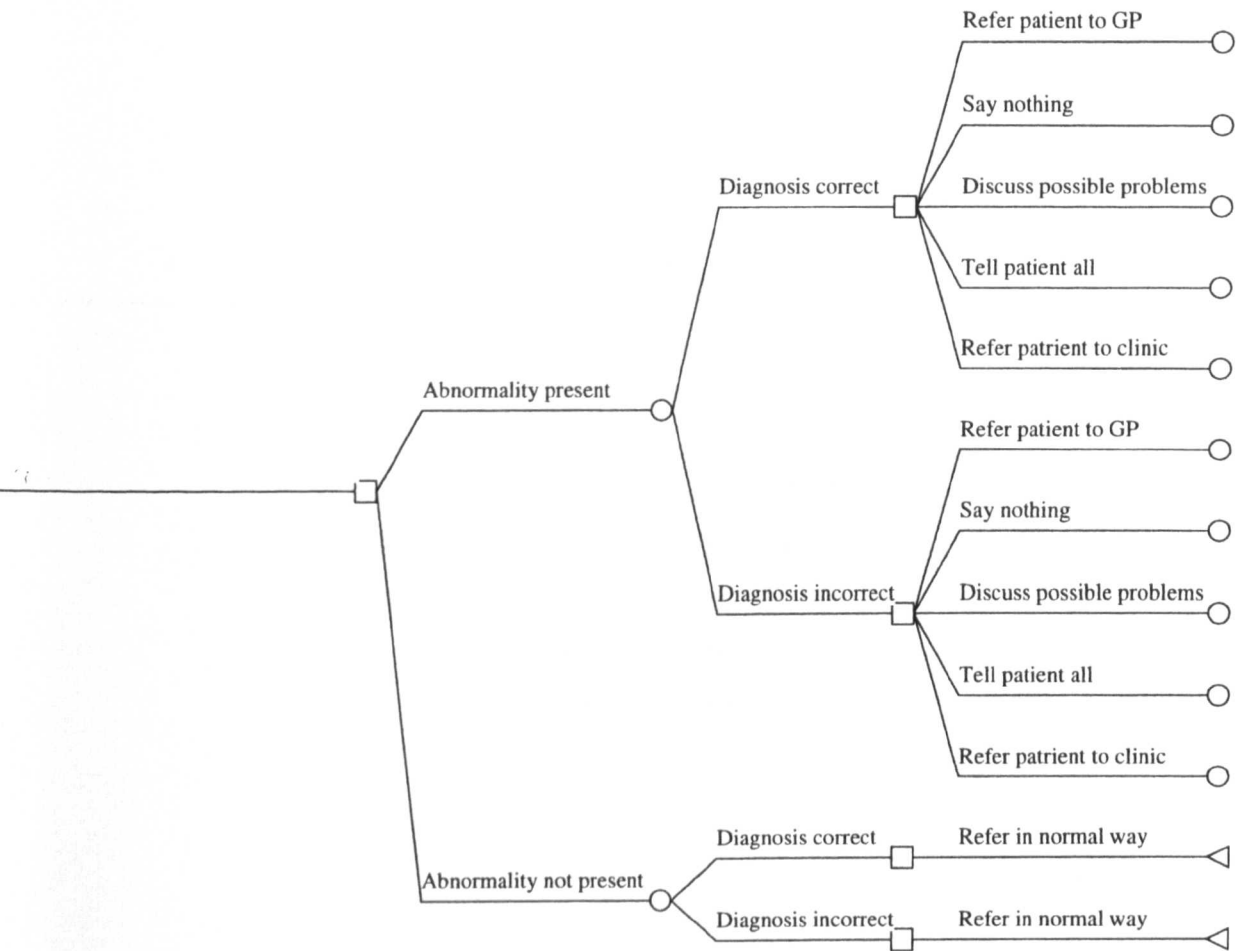
Tree 1
 Tree produced by
 Sonography Educator
 during the piloting of the
 DATA software.





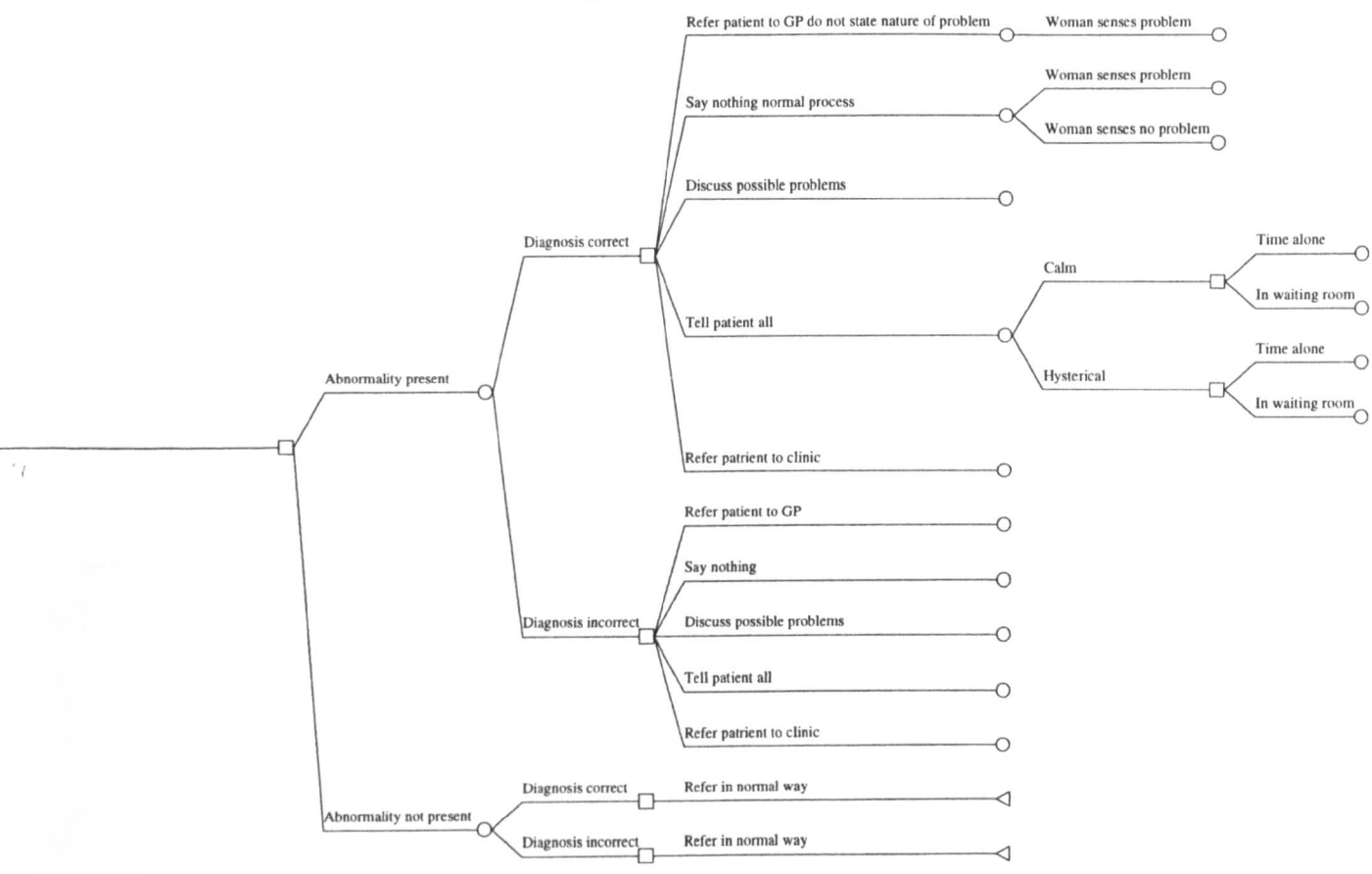
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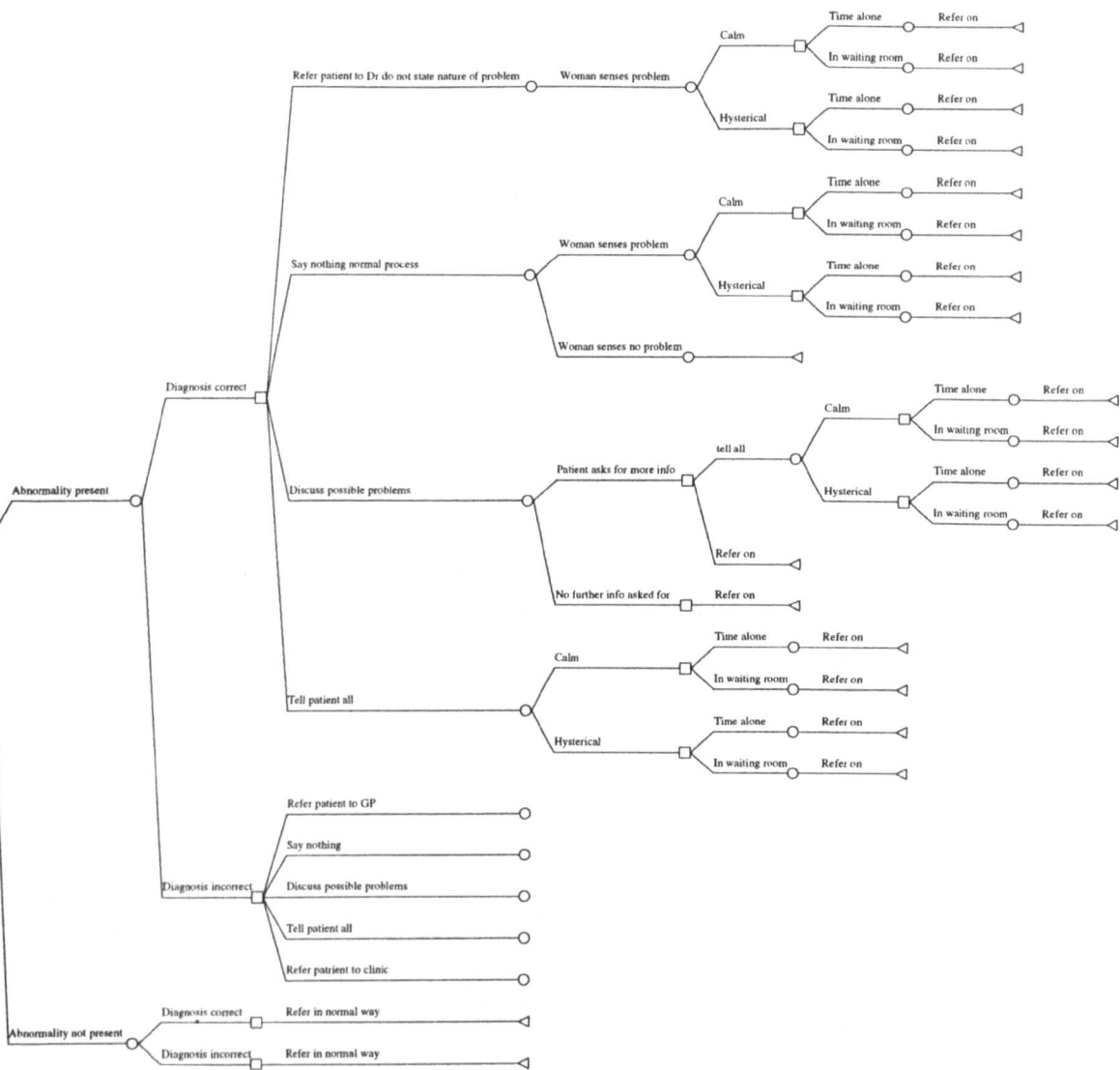


Appendix 3

C2

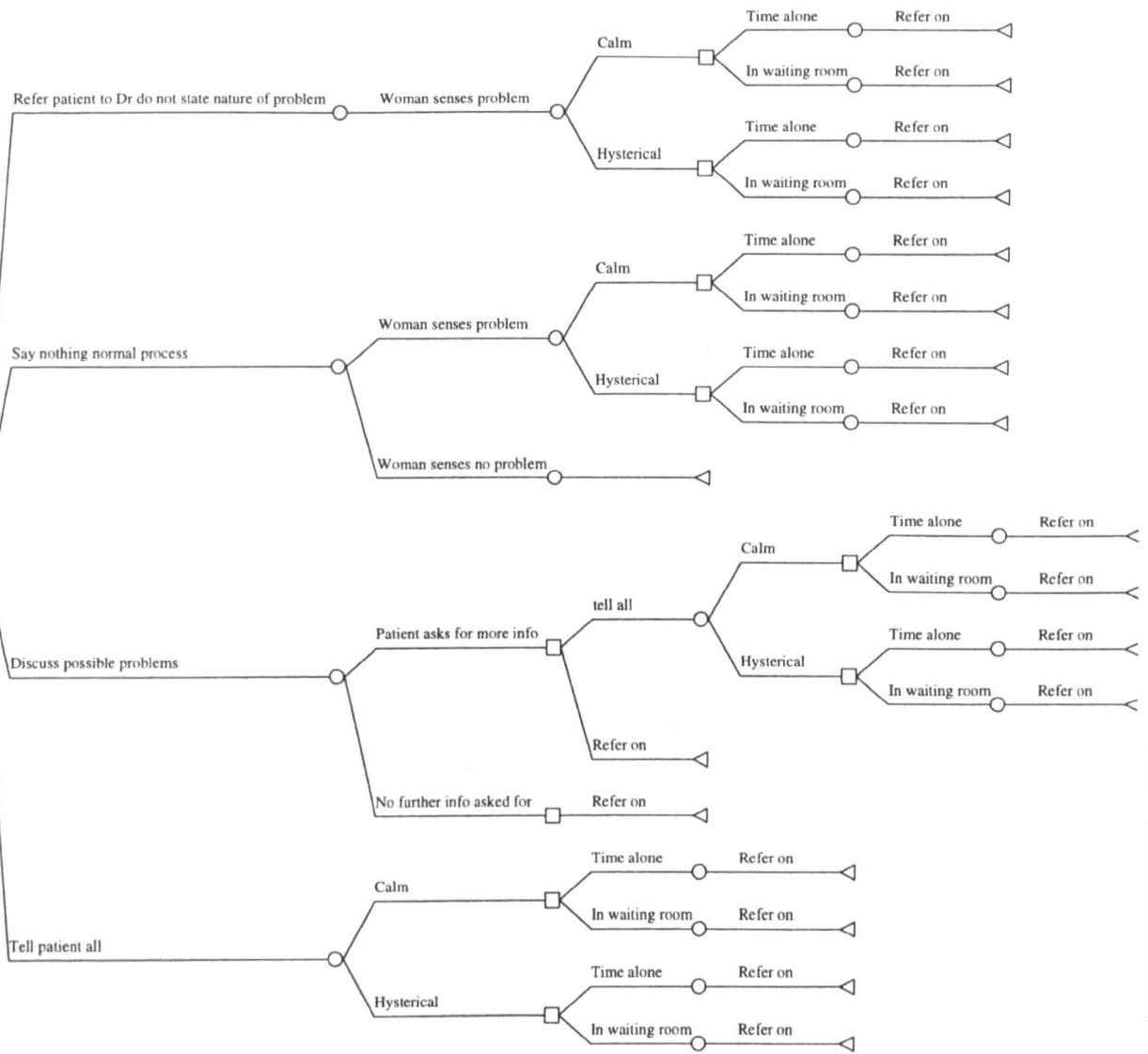


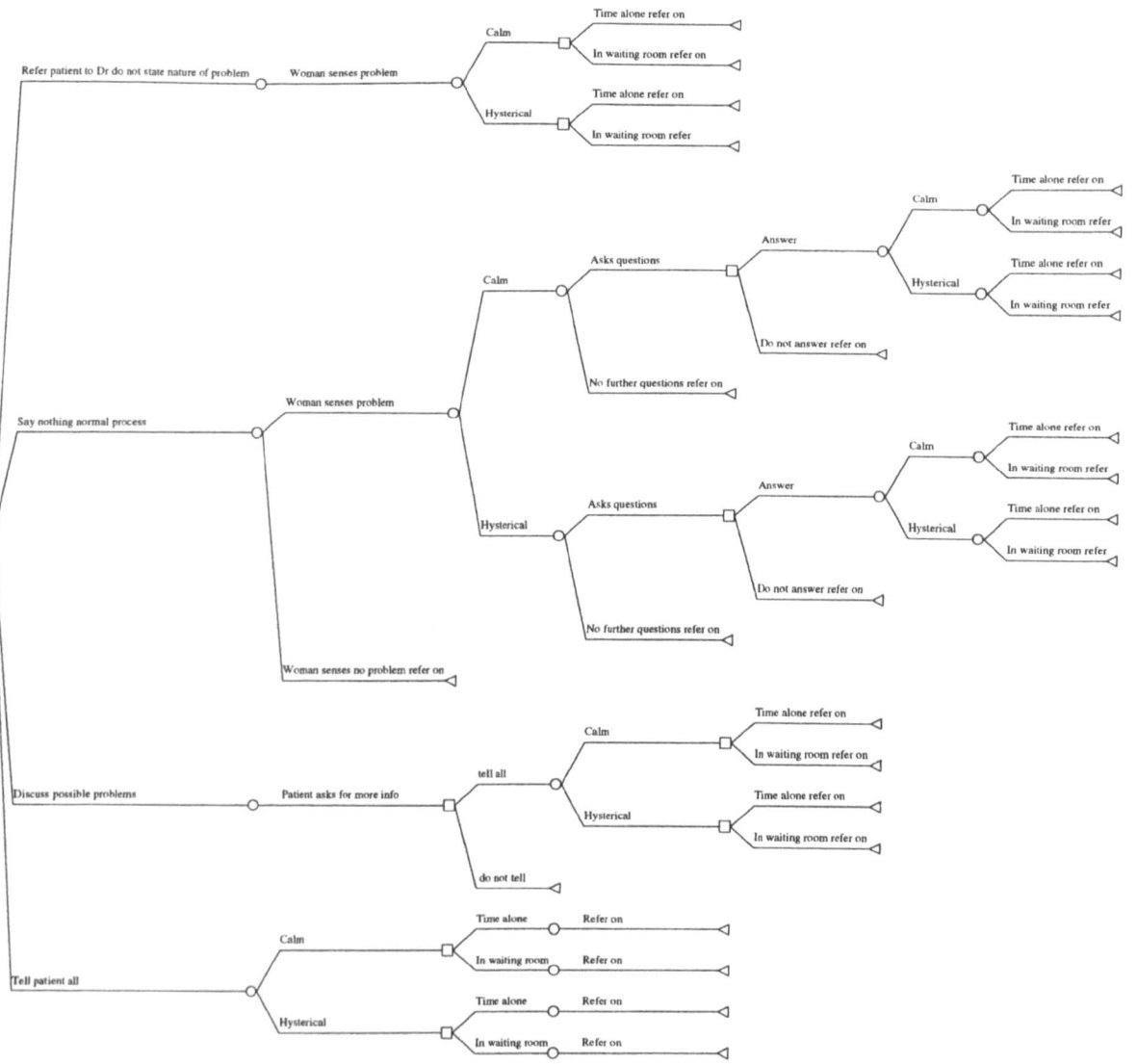
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C3



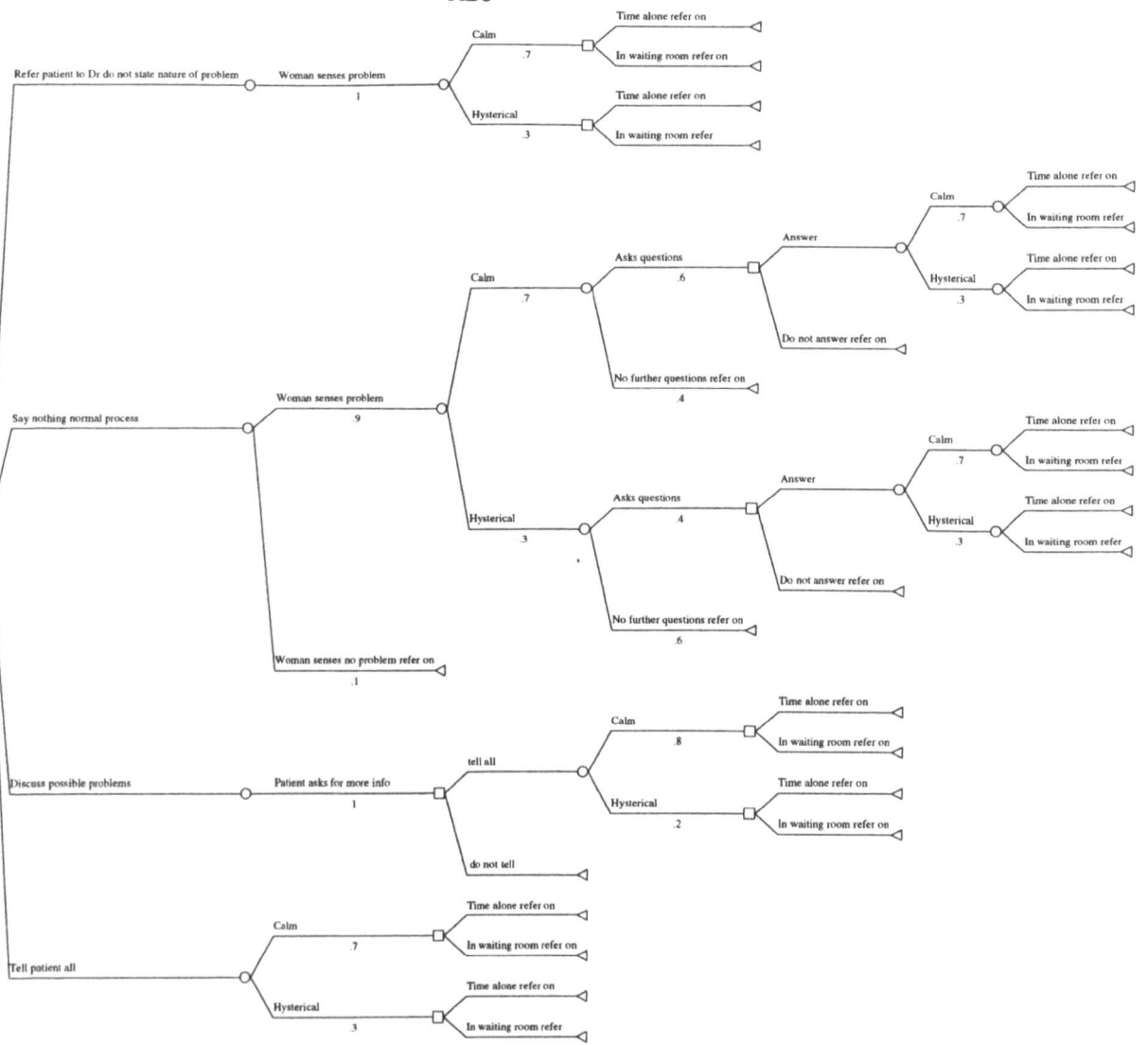
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C4

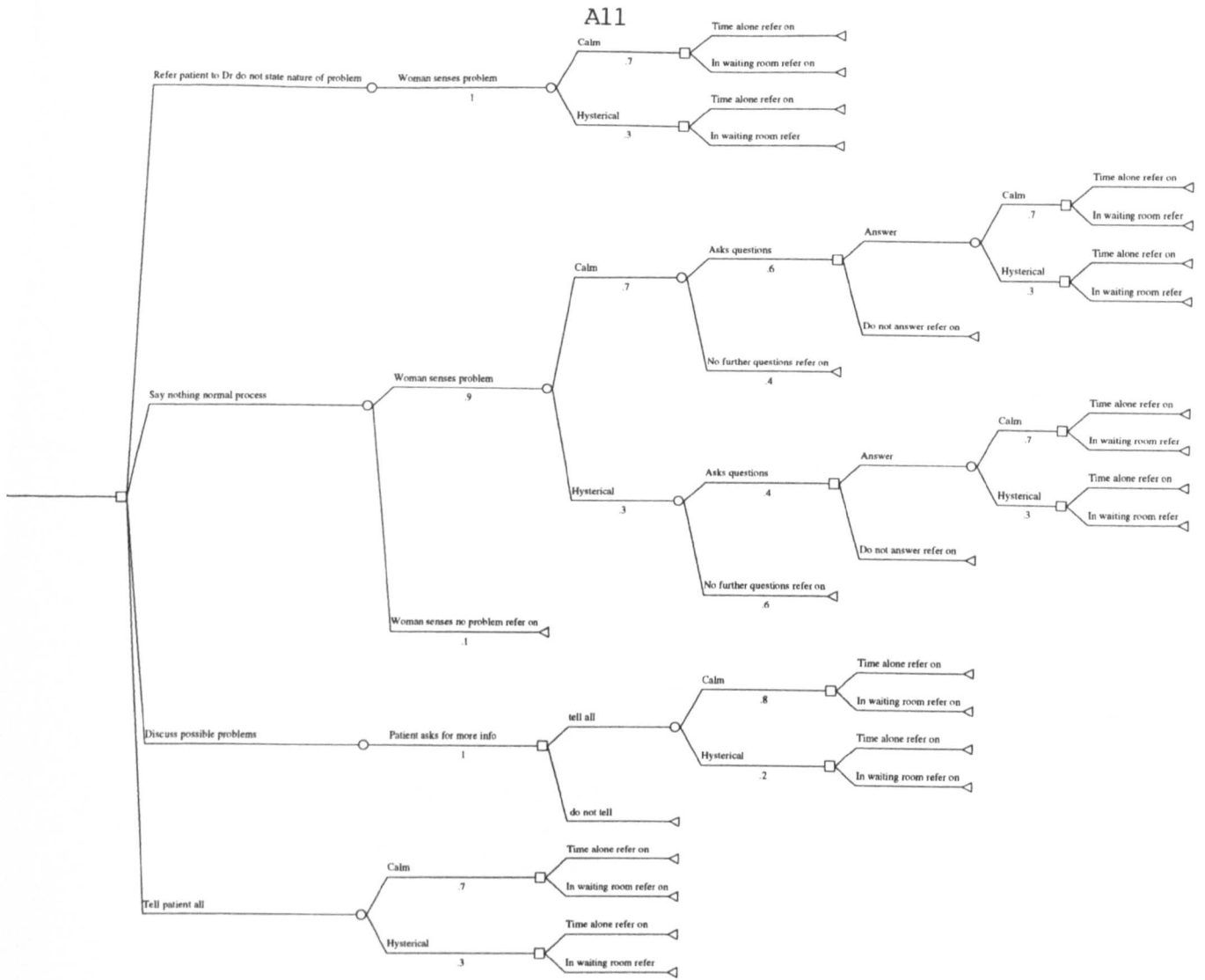




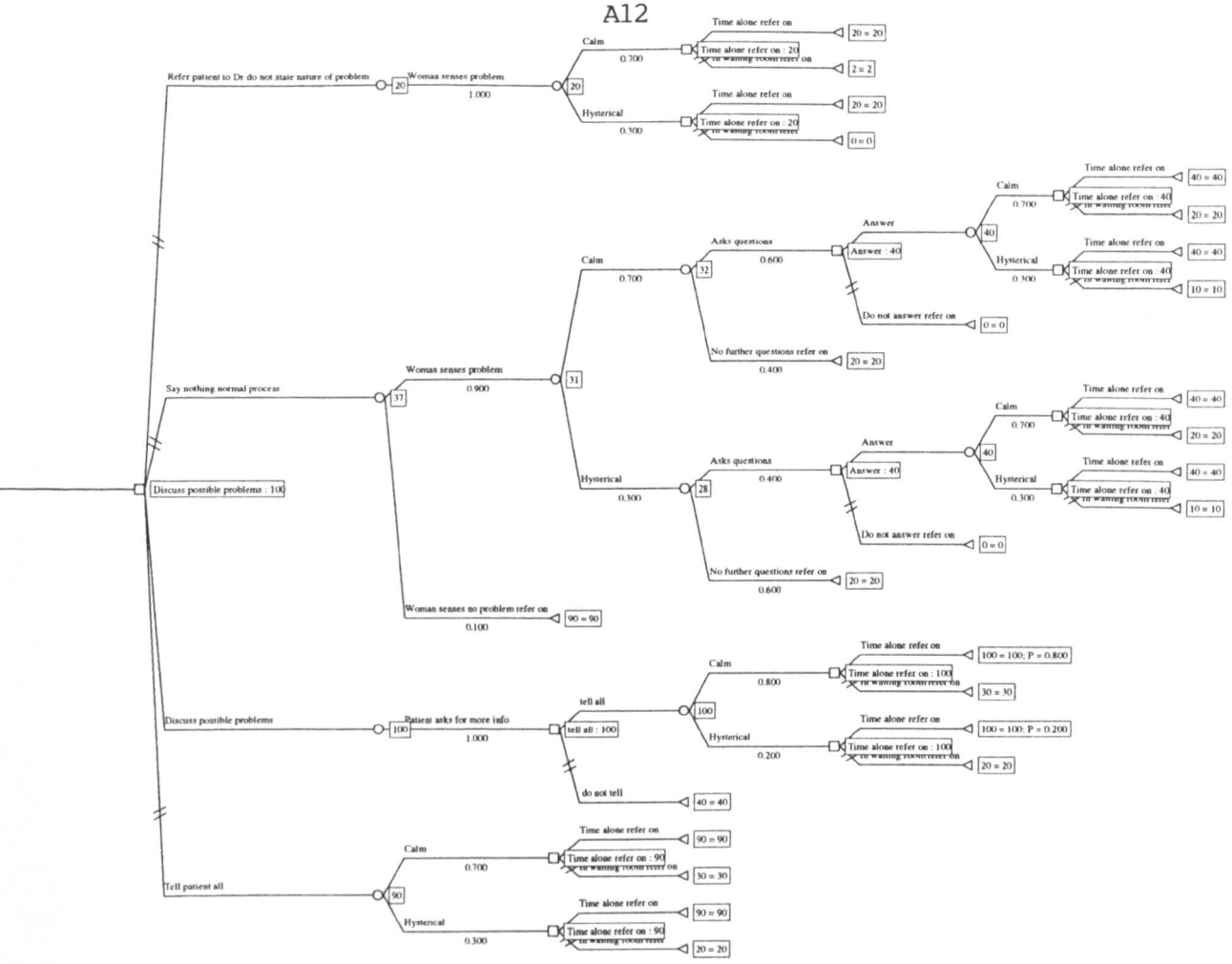
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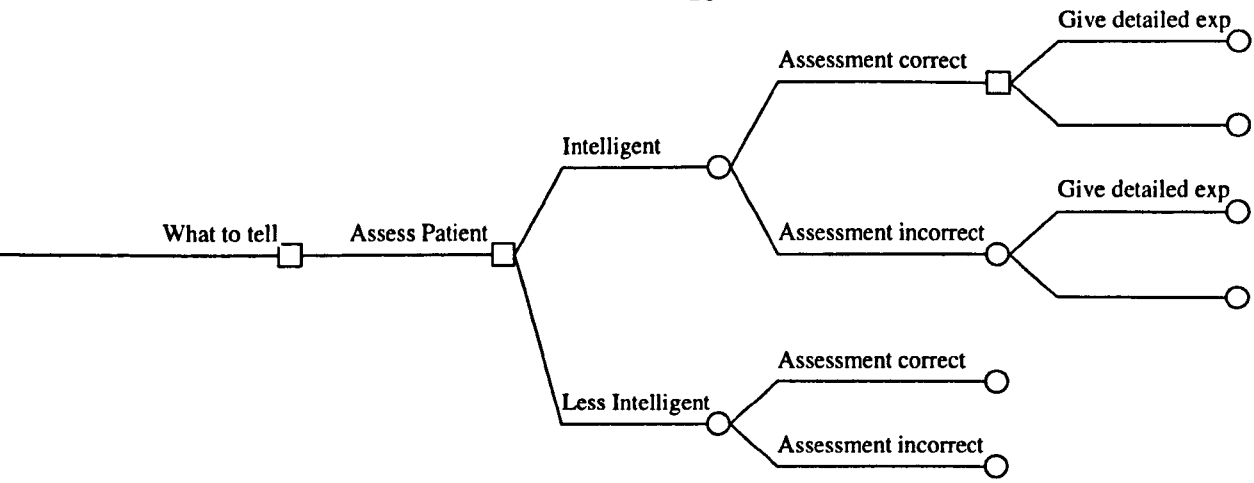
All



A12



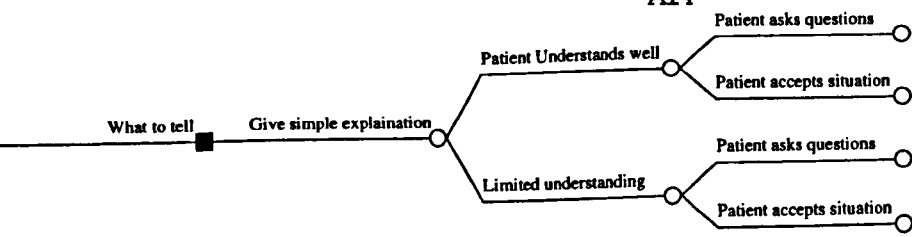
A13



Appendix 4

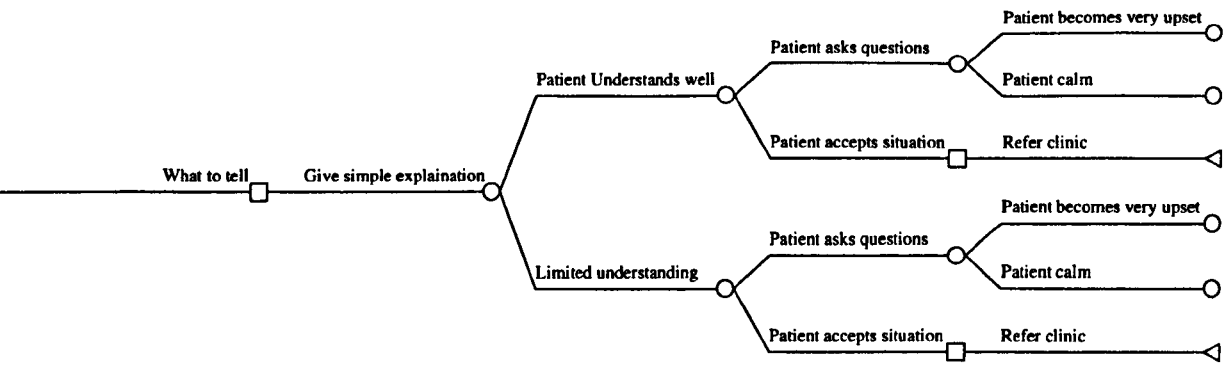
G1

A14



Appendix 4

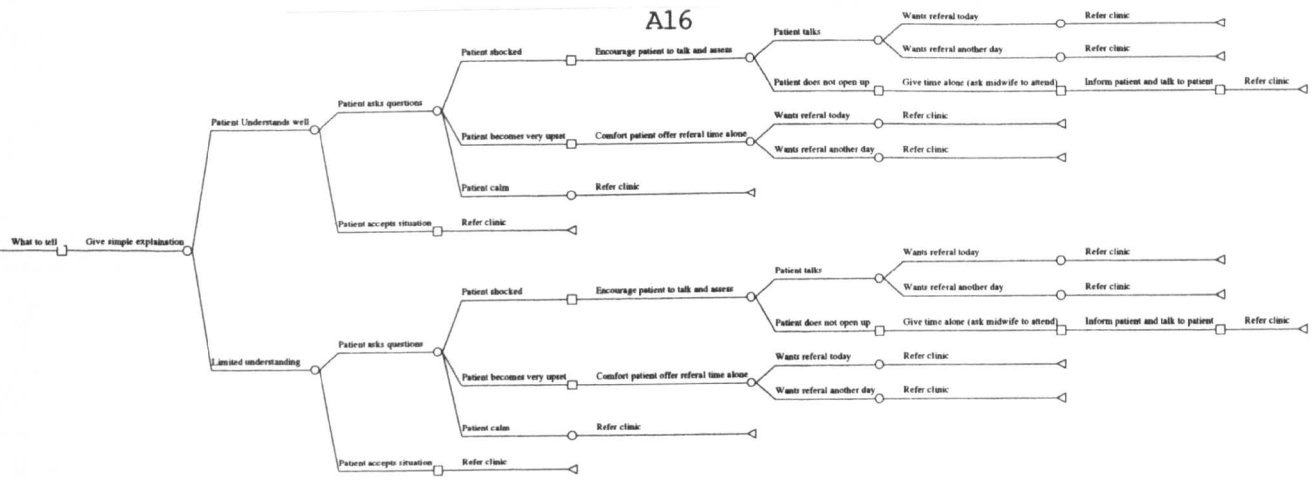
G2



Appendix 4

G3

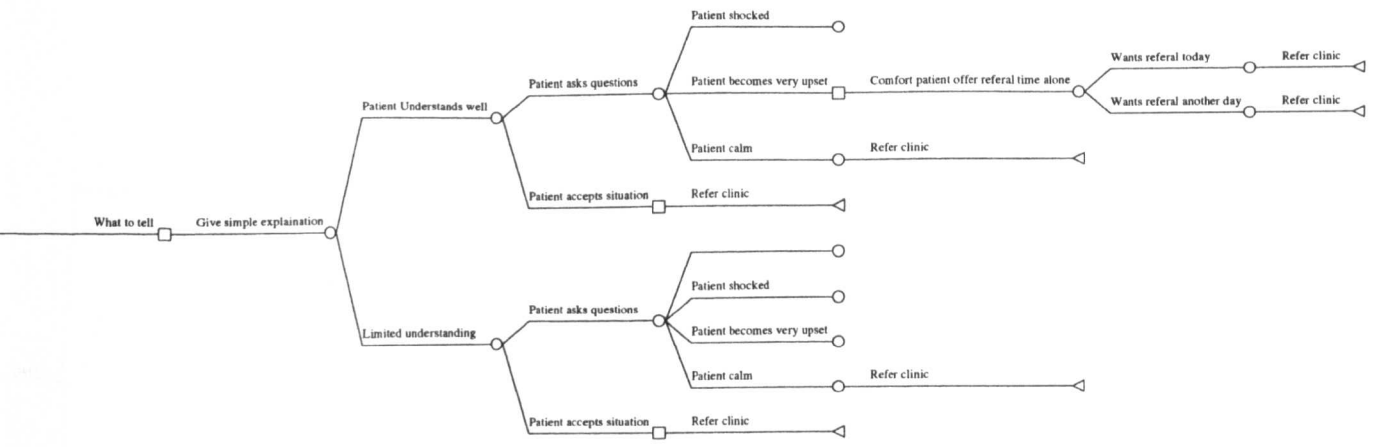
A16



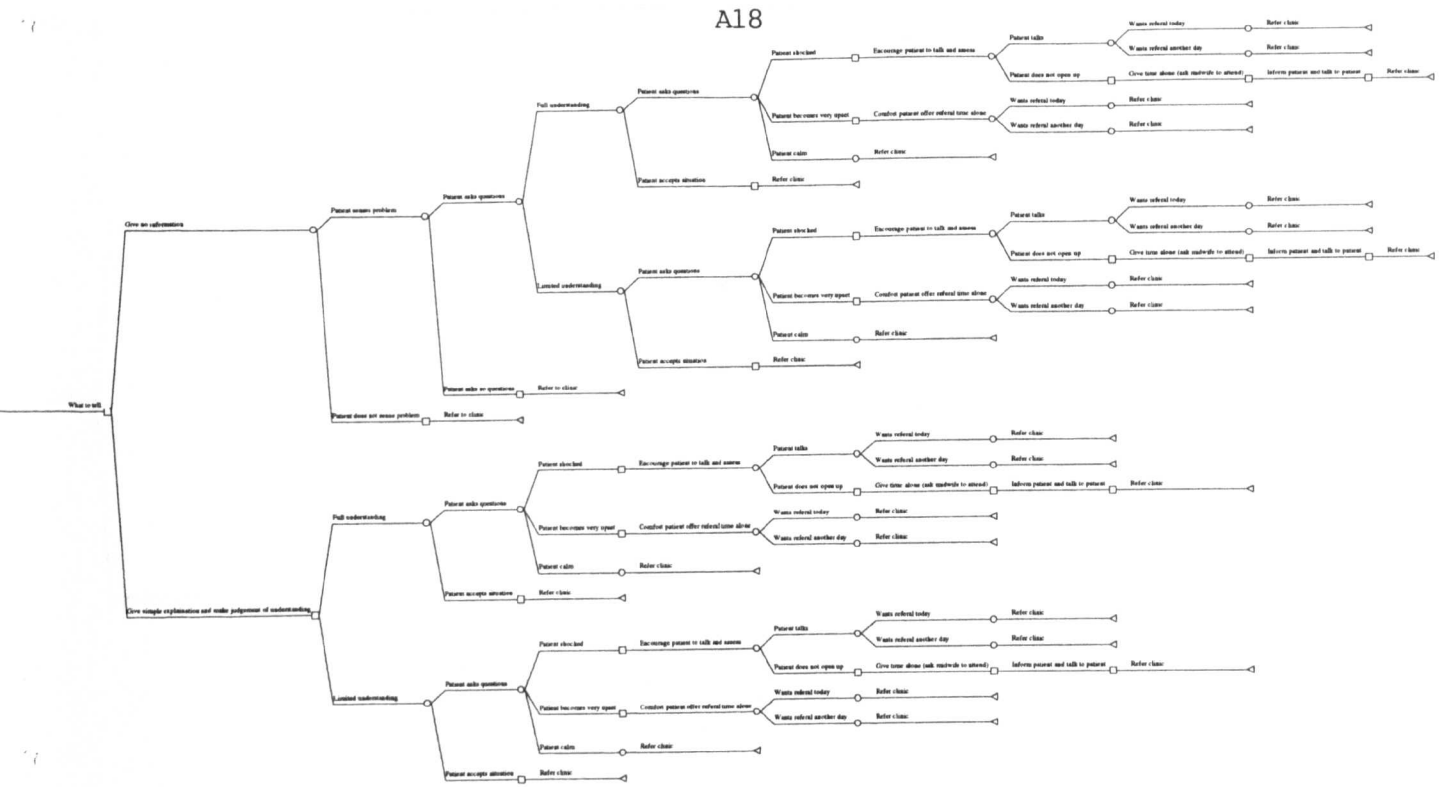
Appendix 4

G4

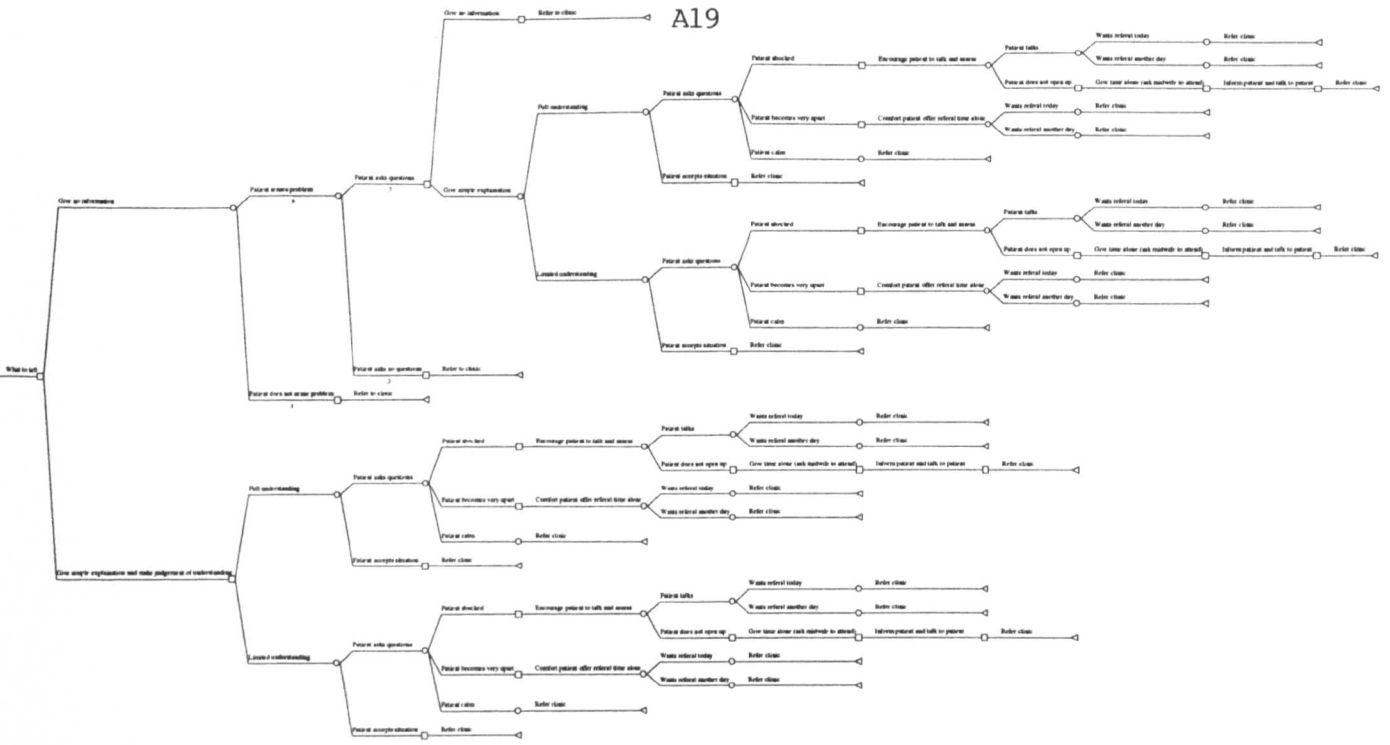
A17



Appendix 4
G5



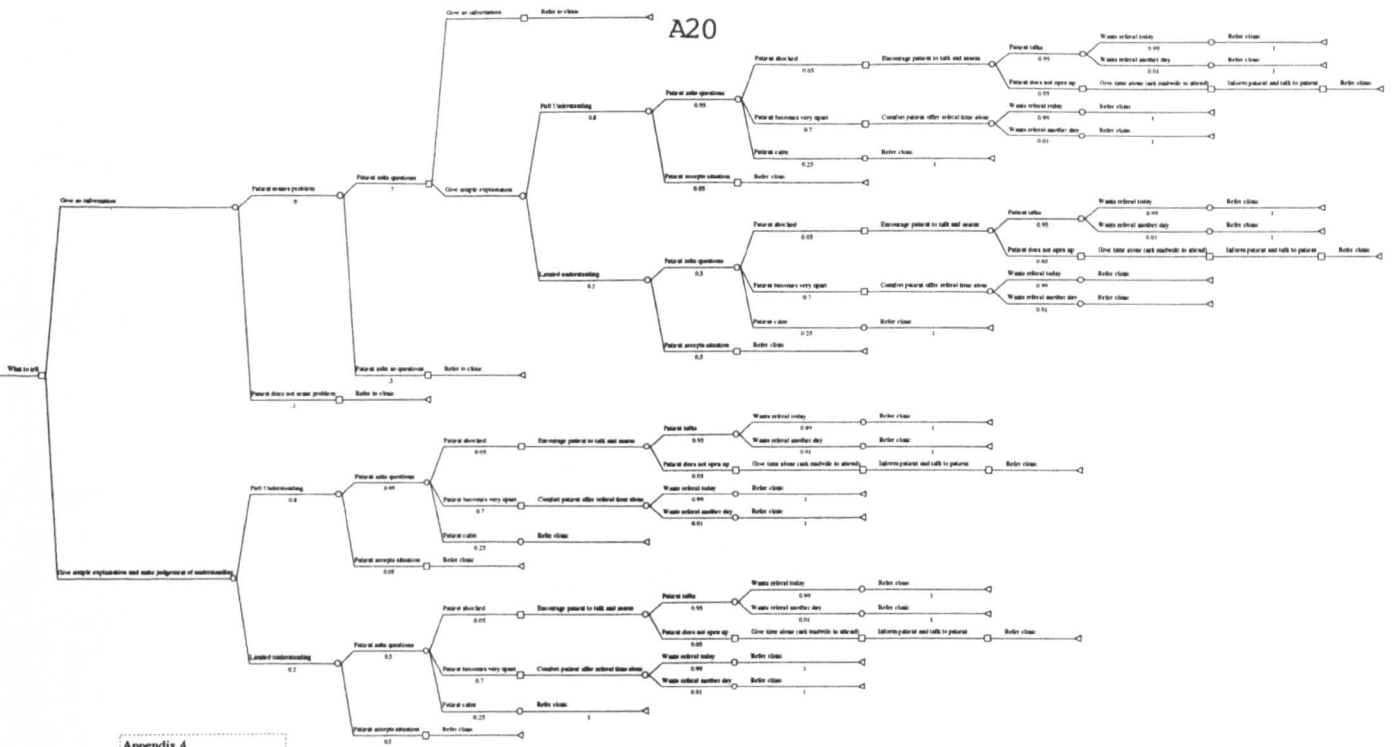
Appendix 4
G6



Appendix 4

G7

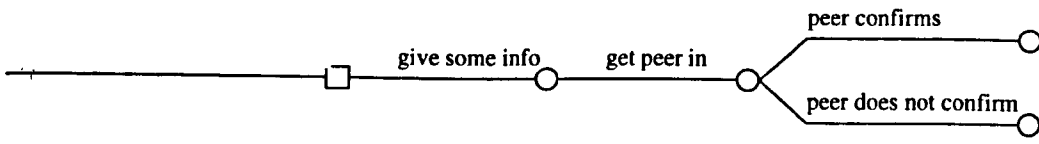
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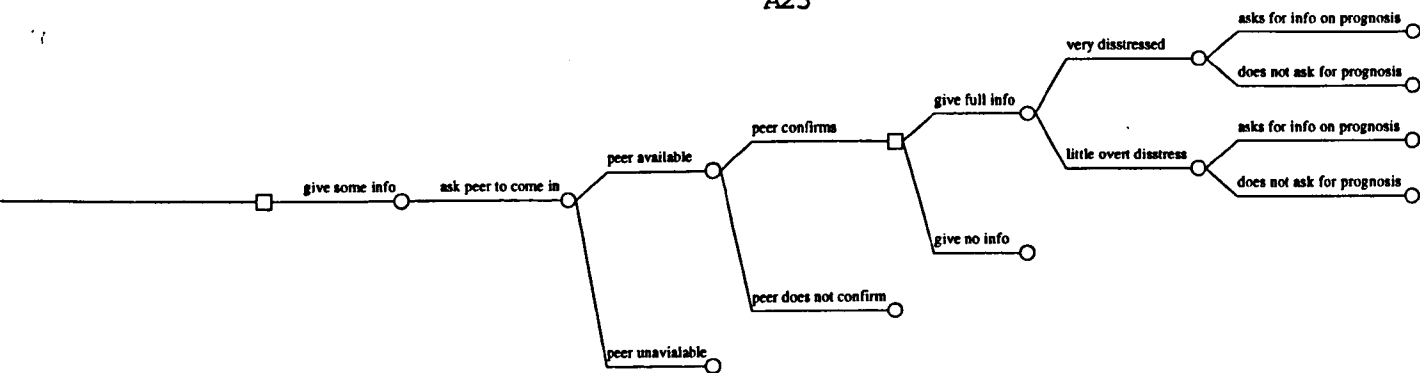
Appendix 4

G8

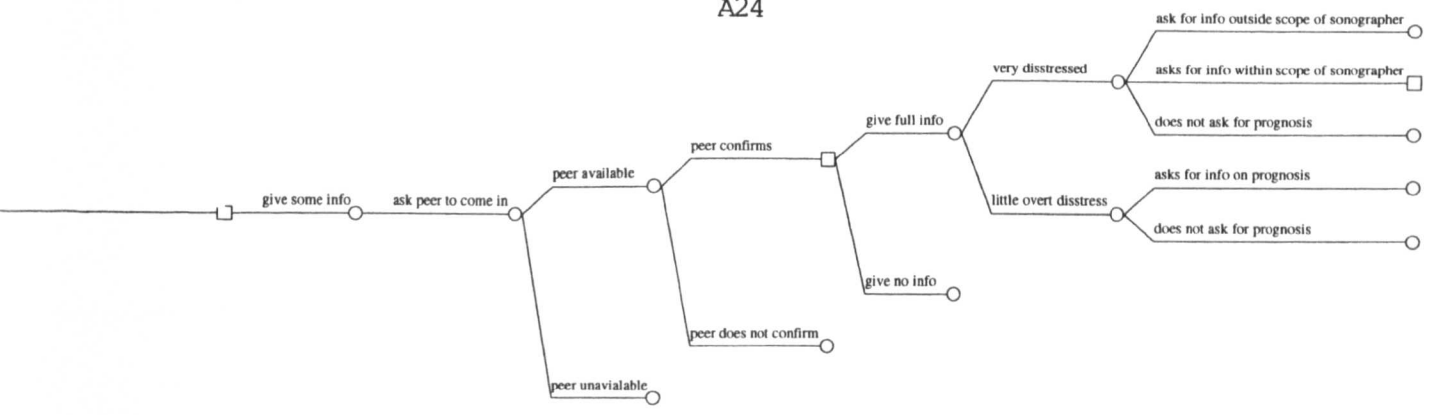
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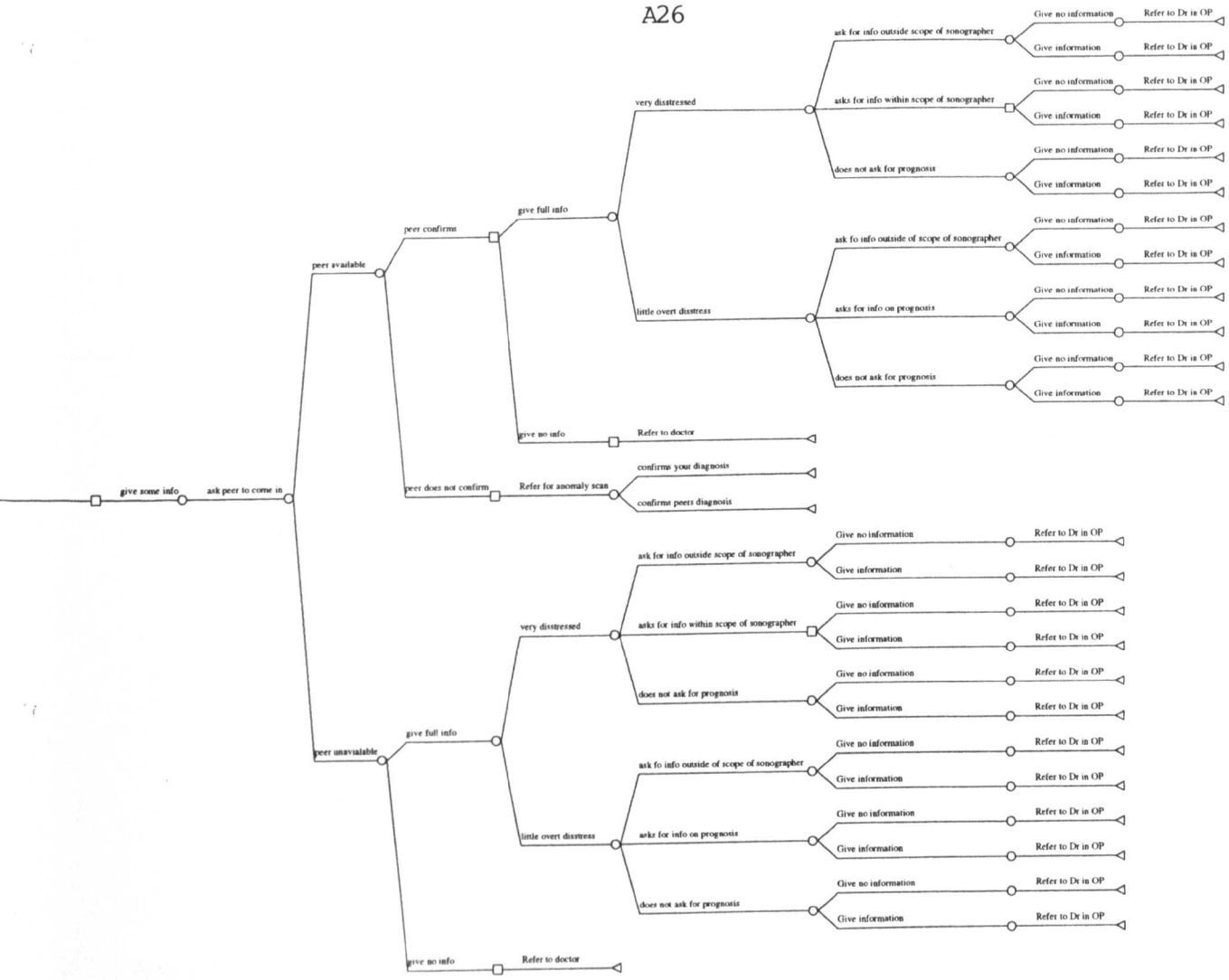
Appendix 5
P1

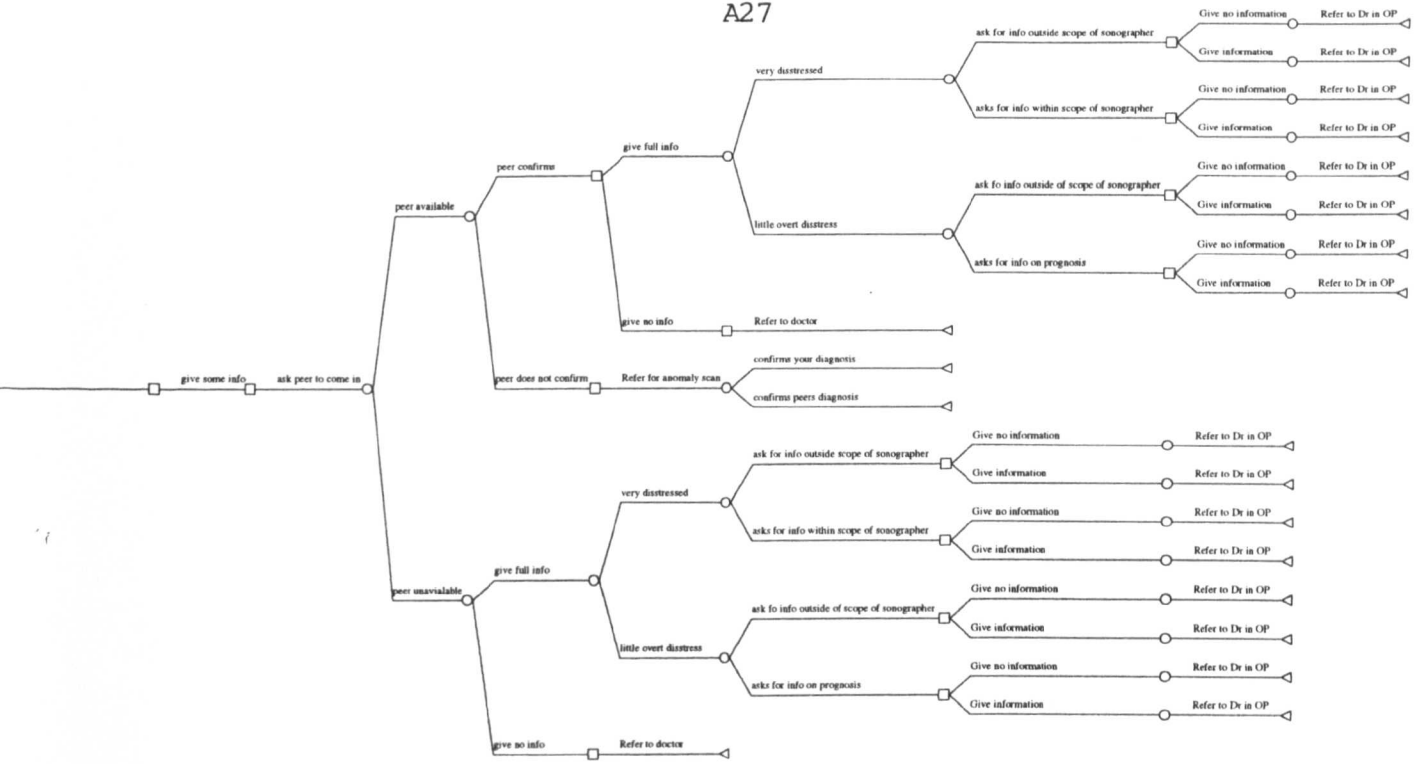


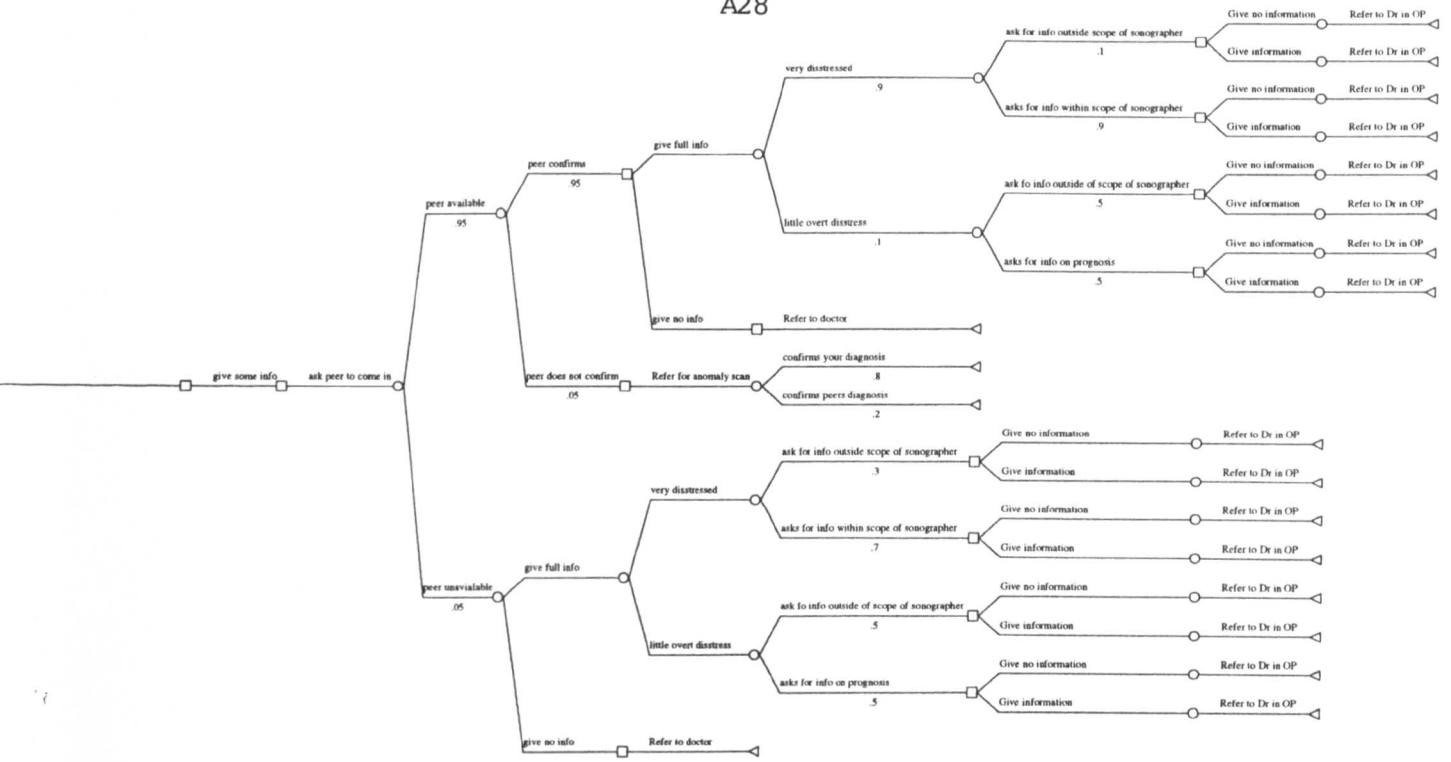
Appendix 5
P2

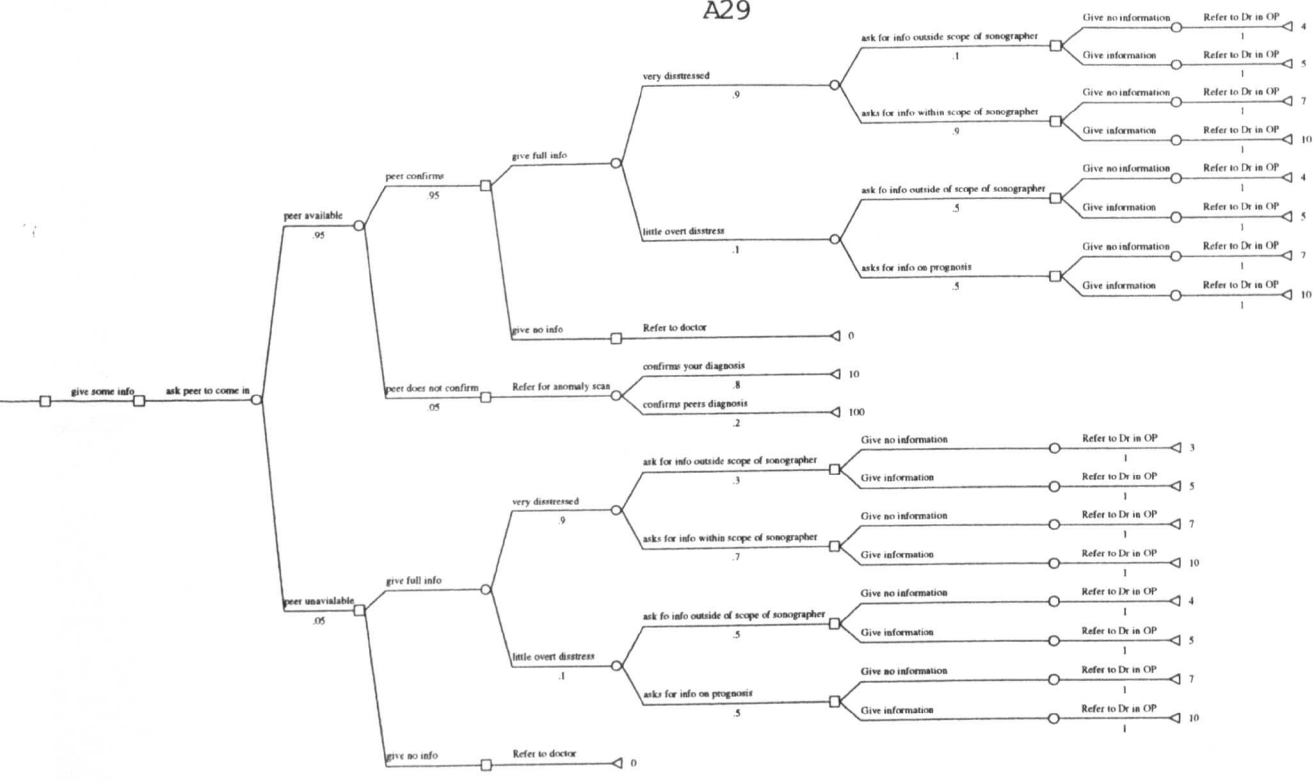


Appendix 5
P3



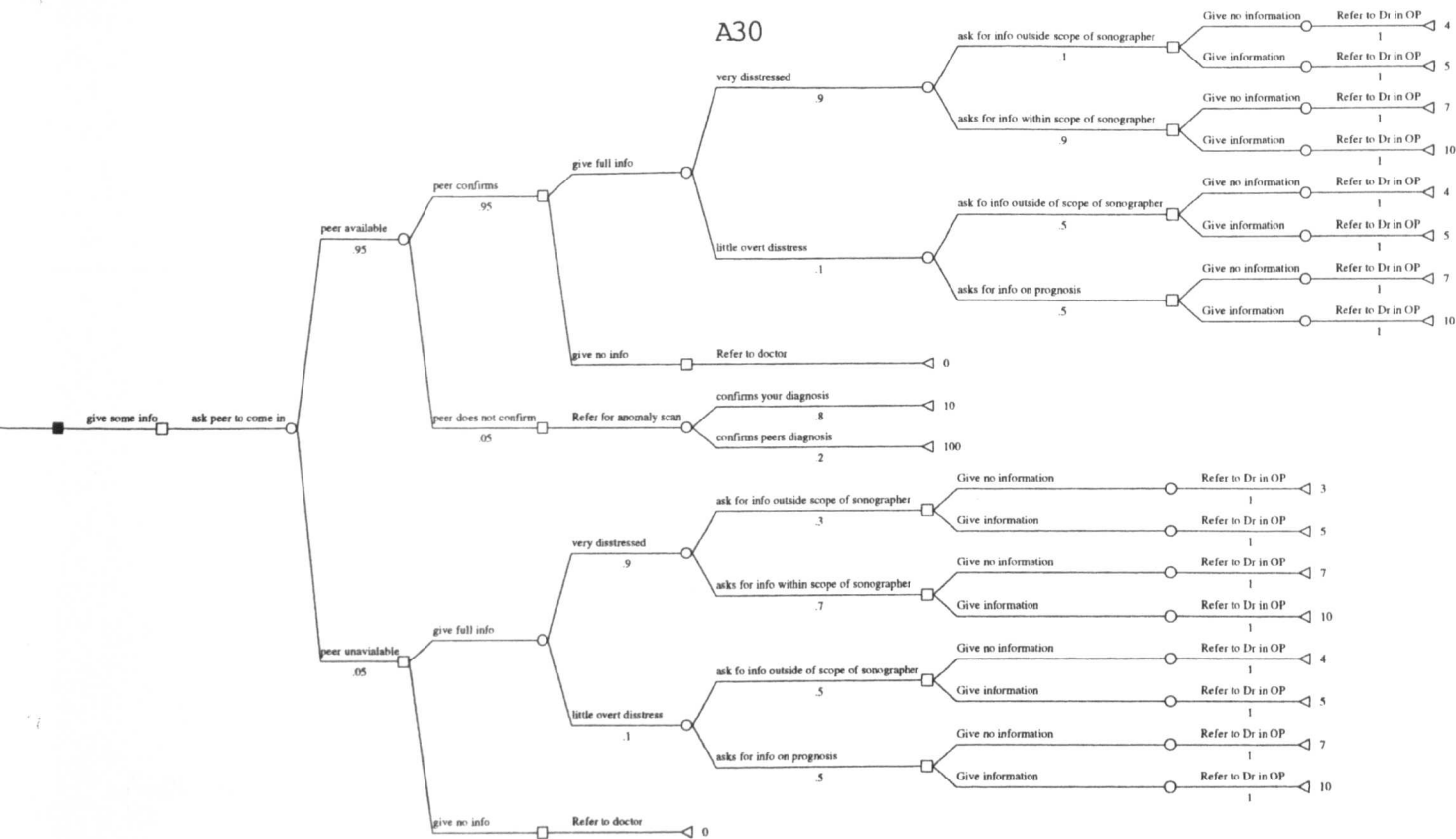






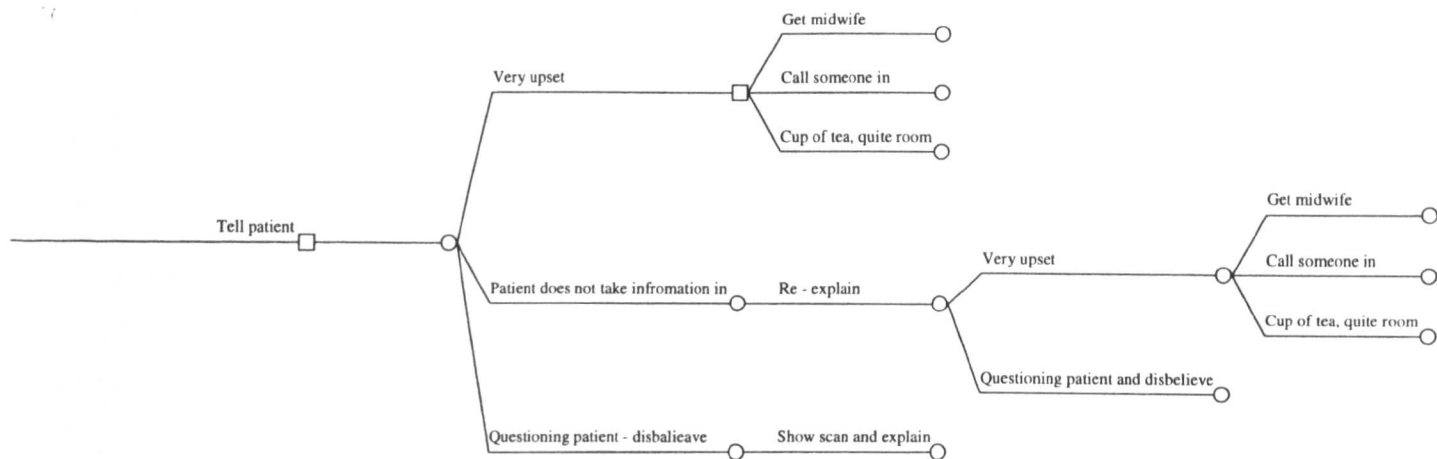
Appendix 5
P8

A30

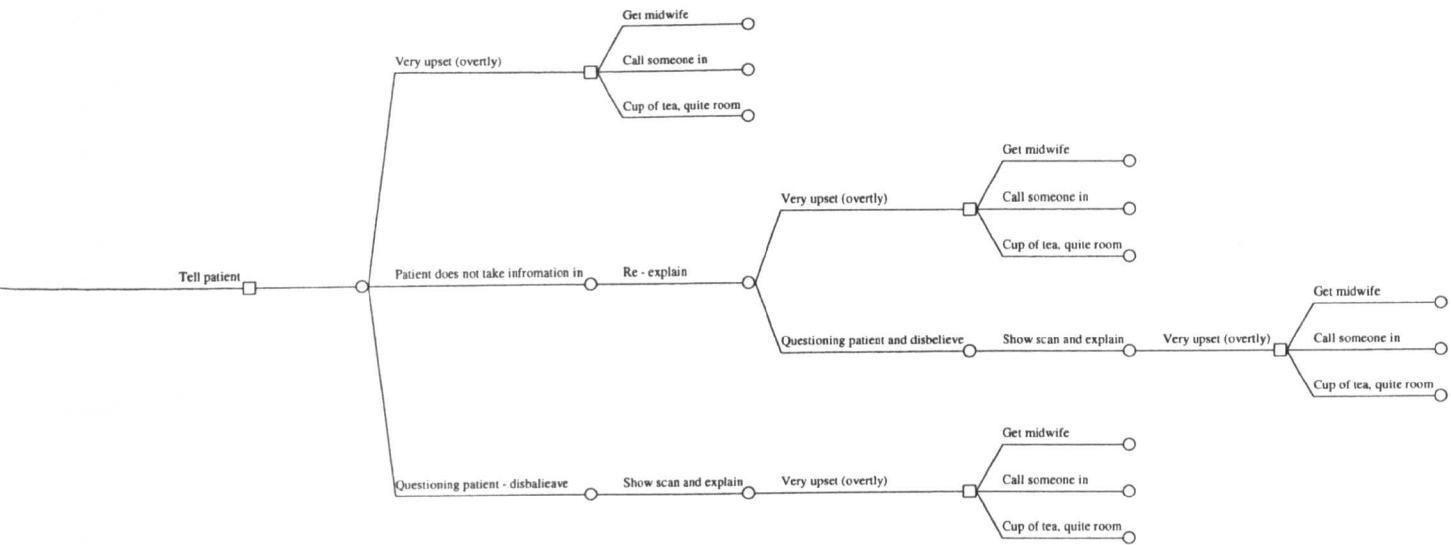


Appendix 5
P9

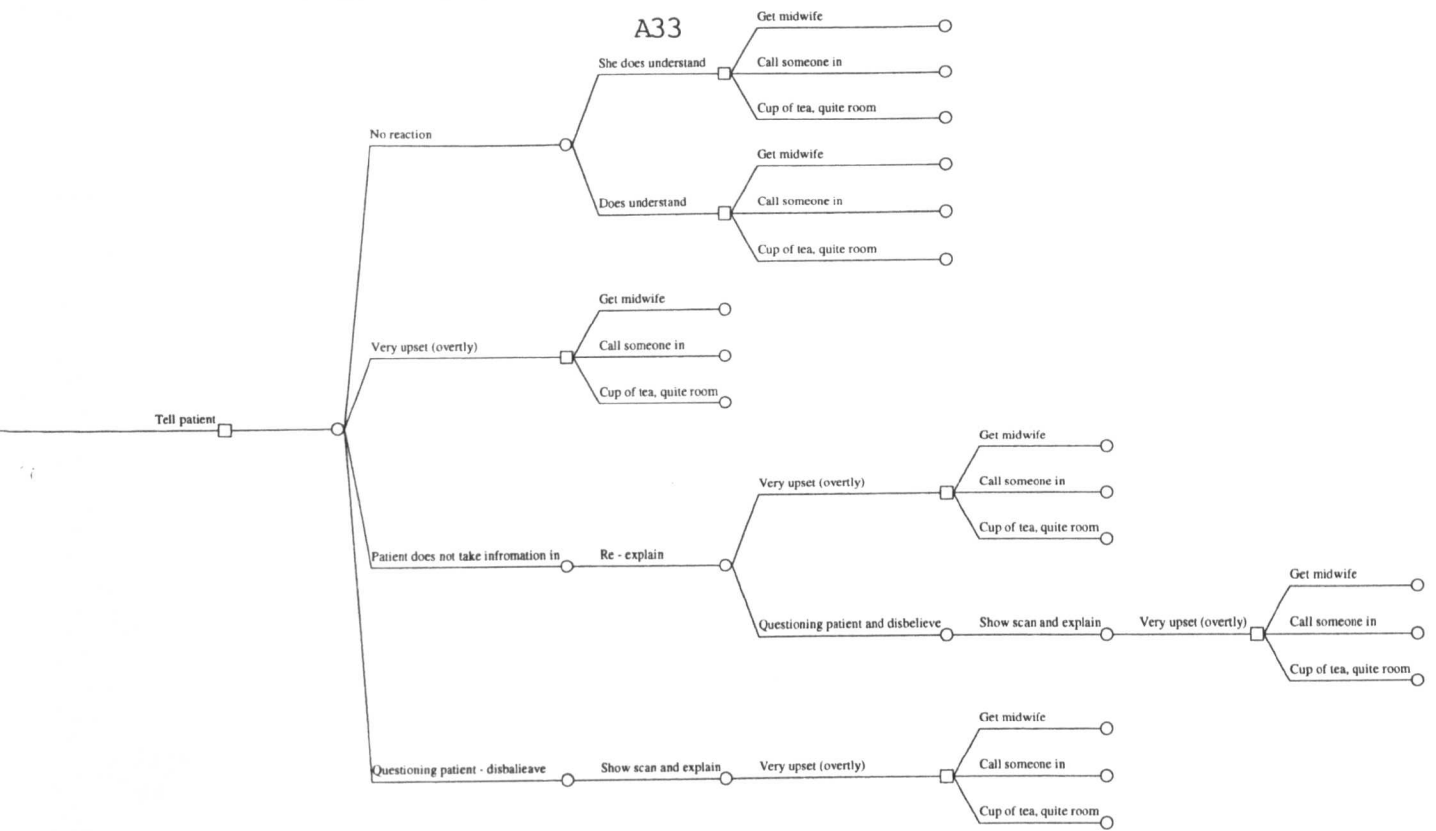
A31



Appendix 6
K1

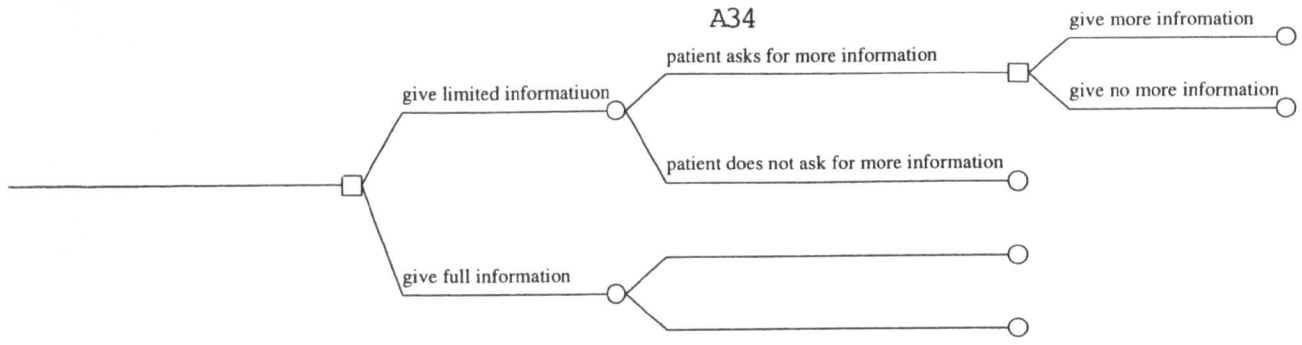


Appendix 6
K2

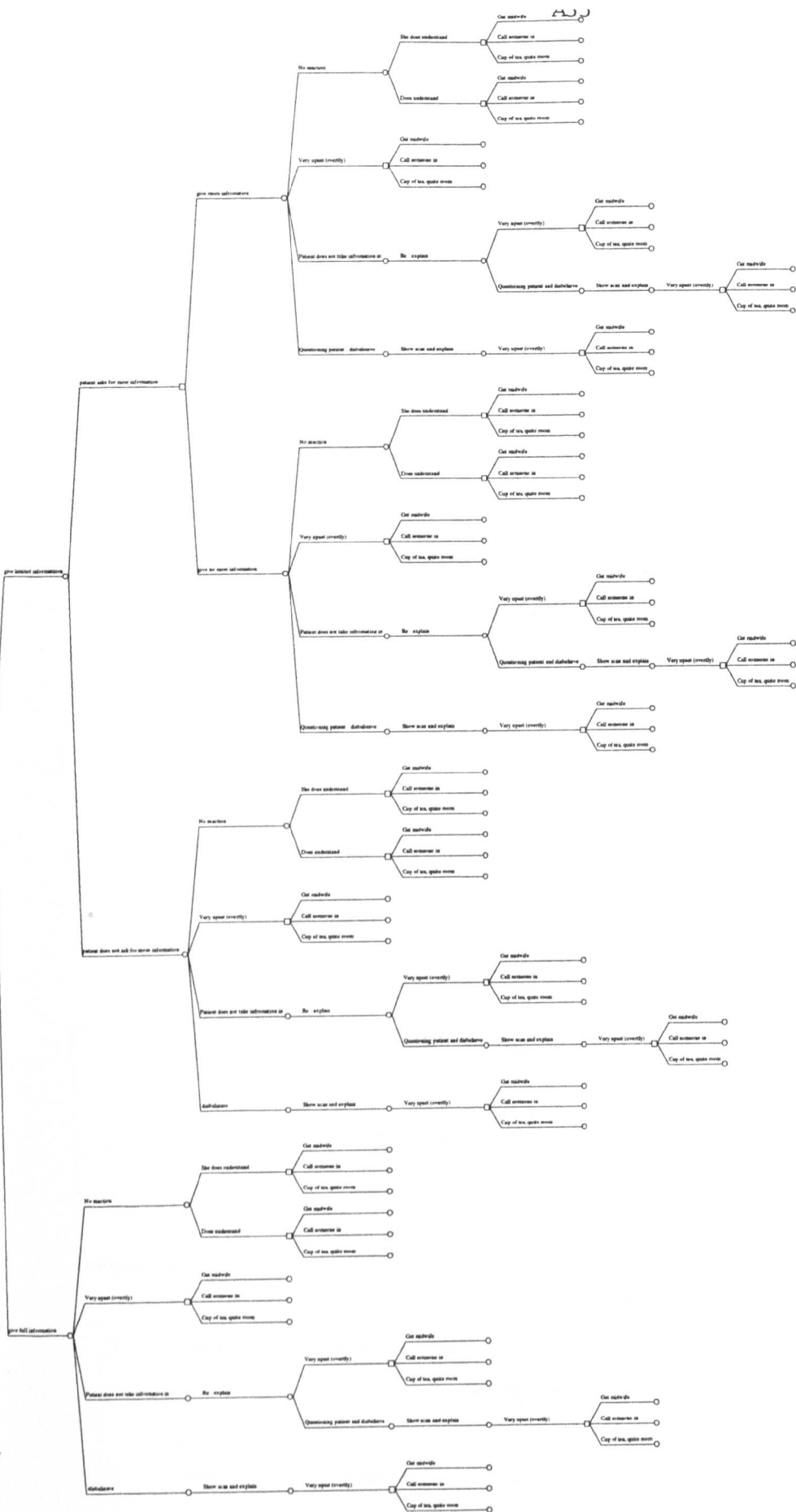


Appendix 6
K3

A34

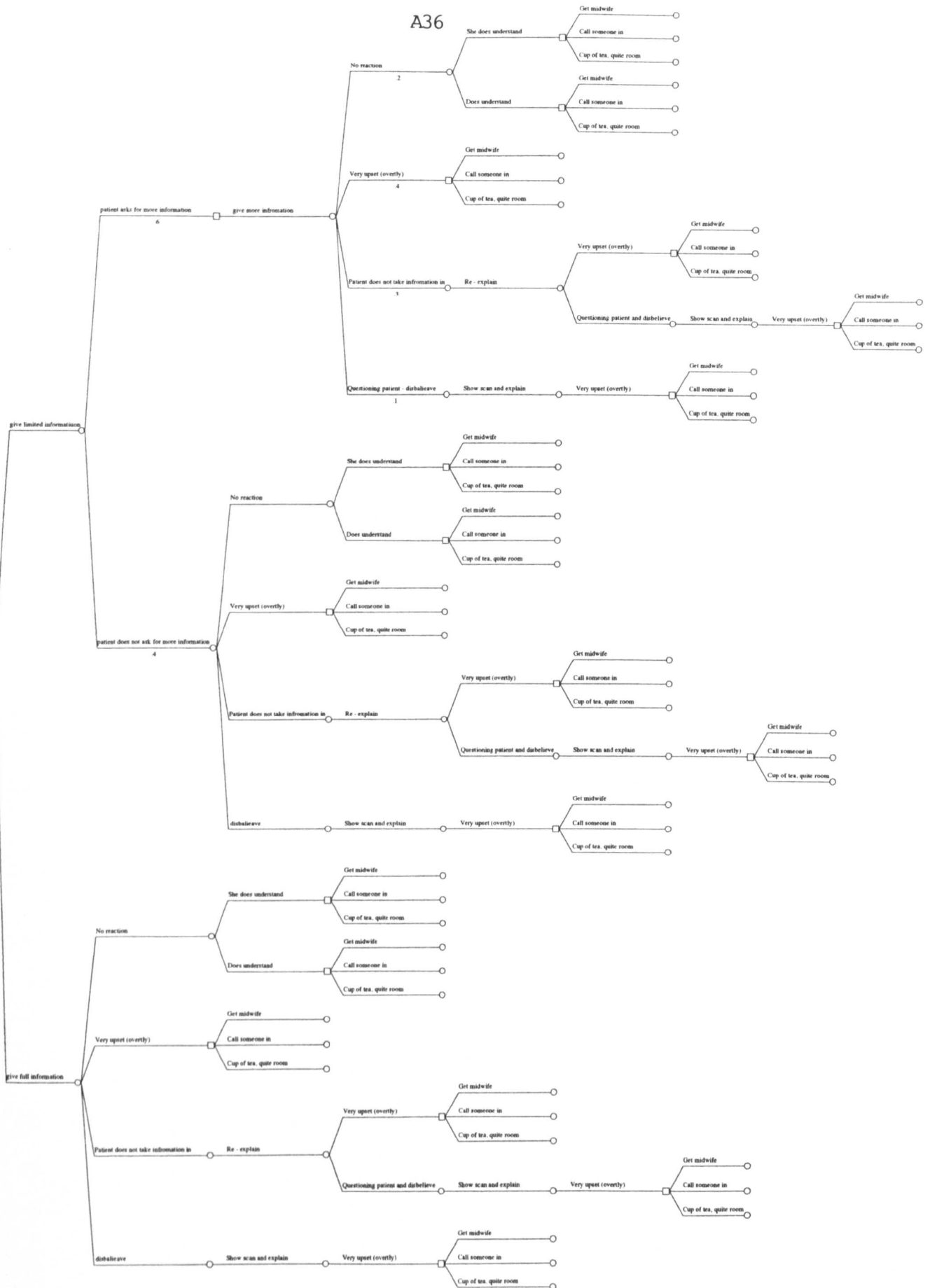


Appendix 6
K4

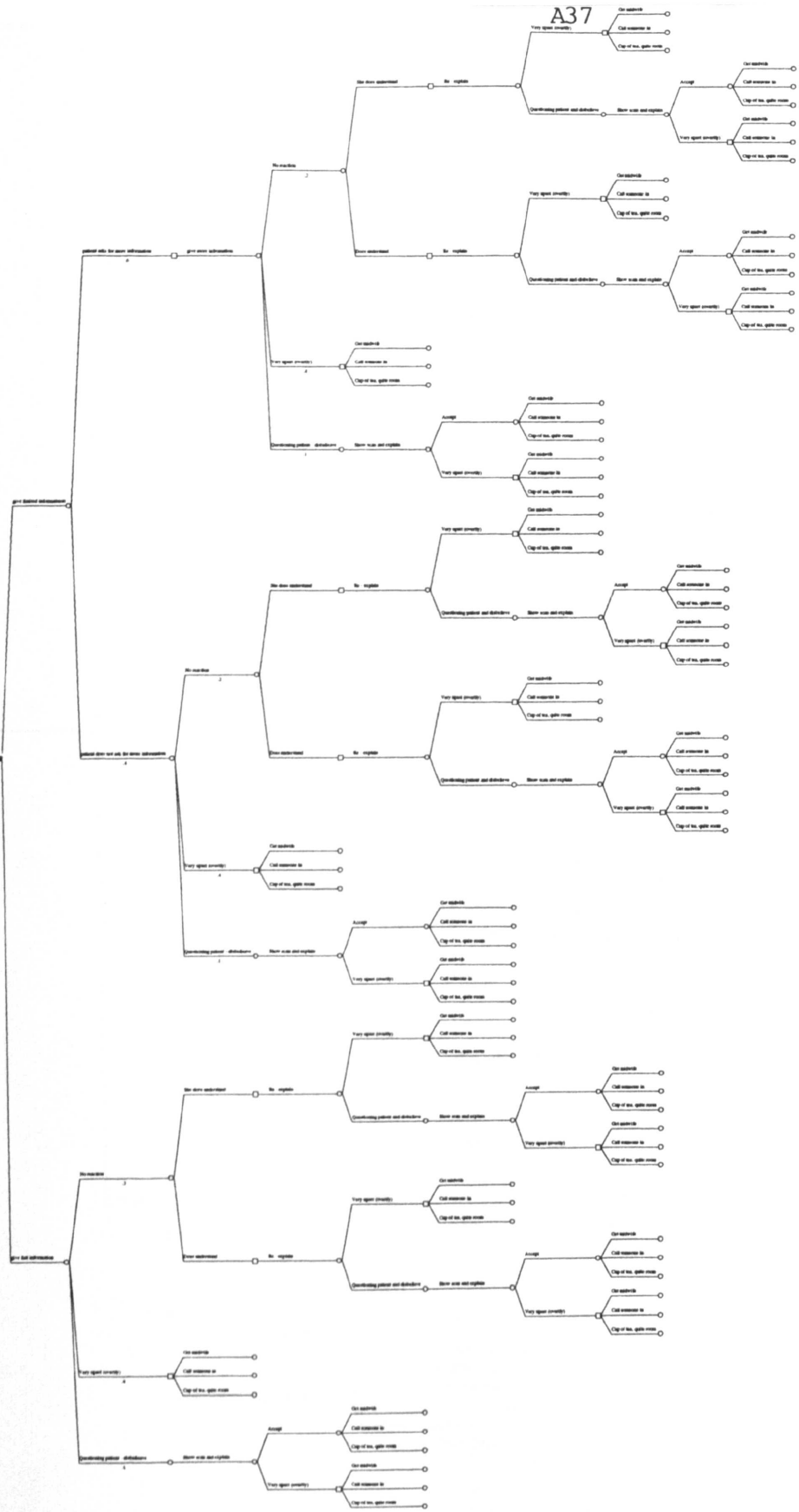


Appendix 6
K5

A36

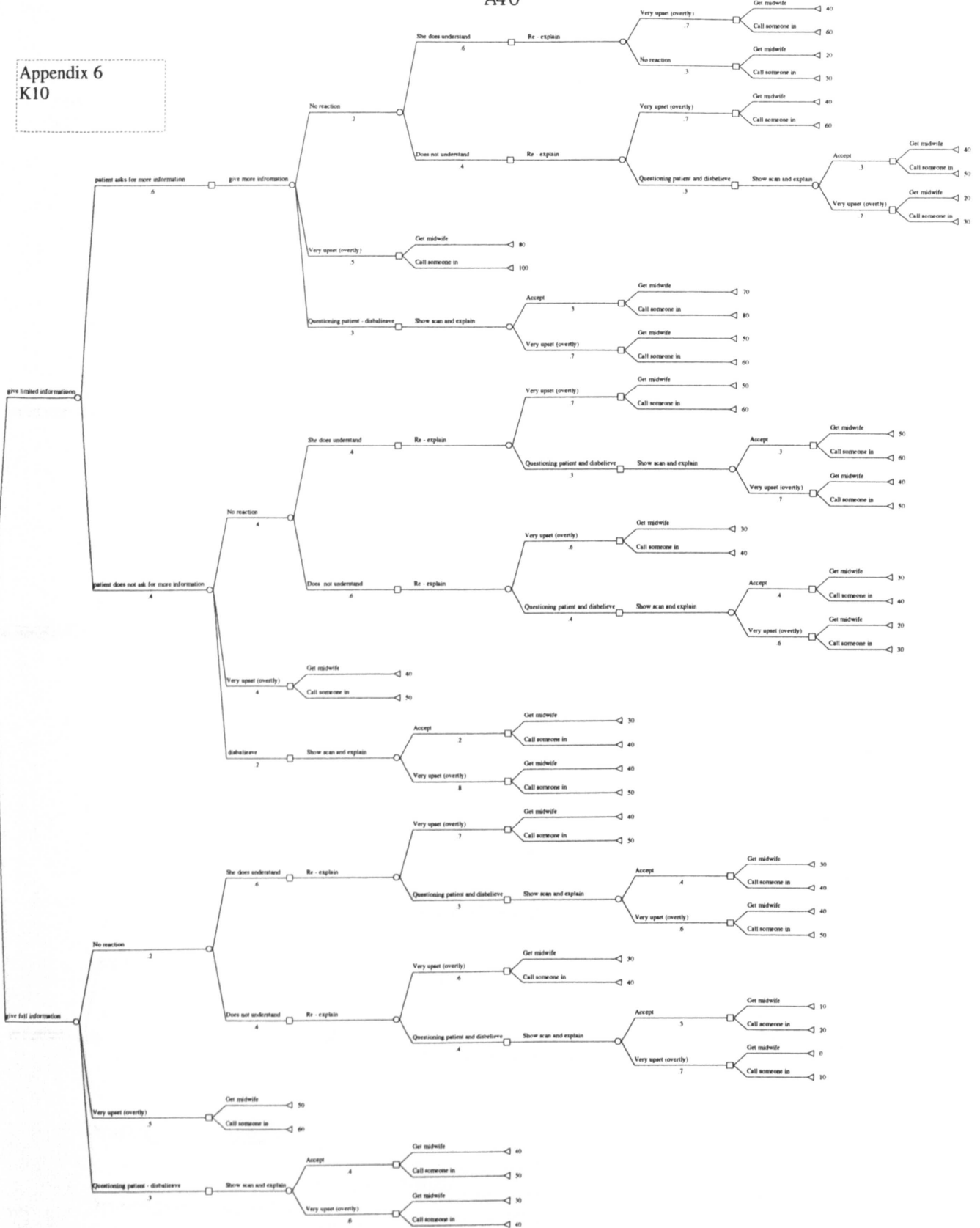


A37

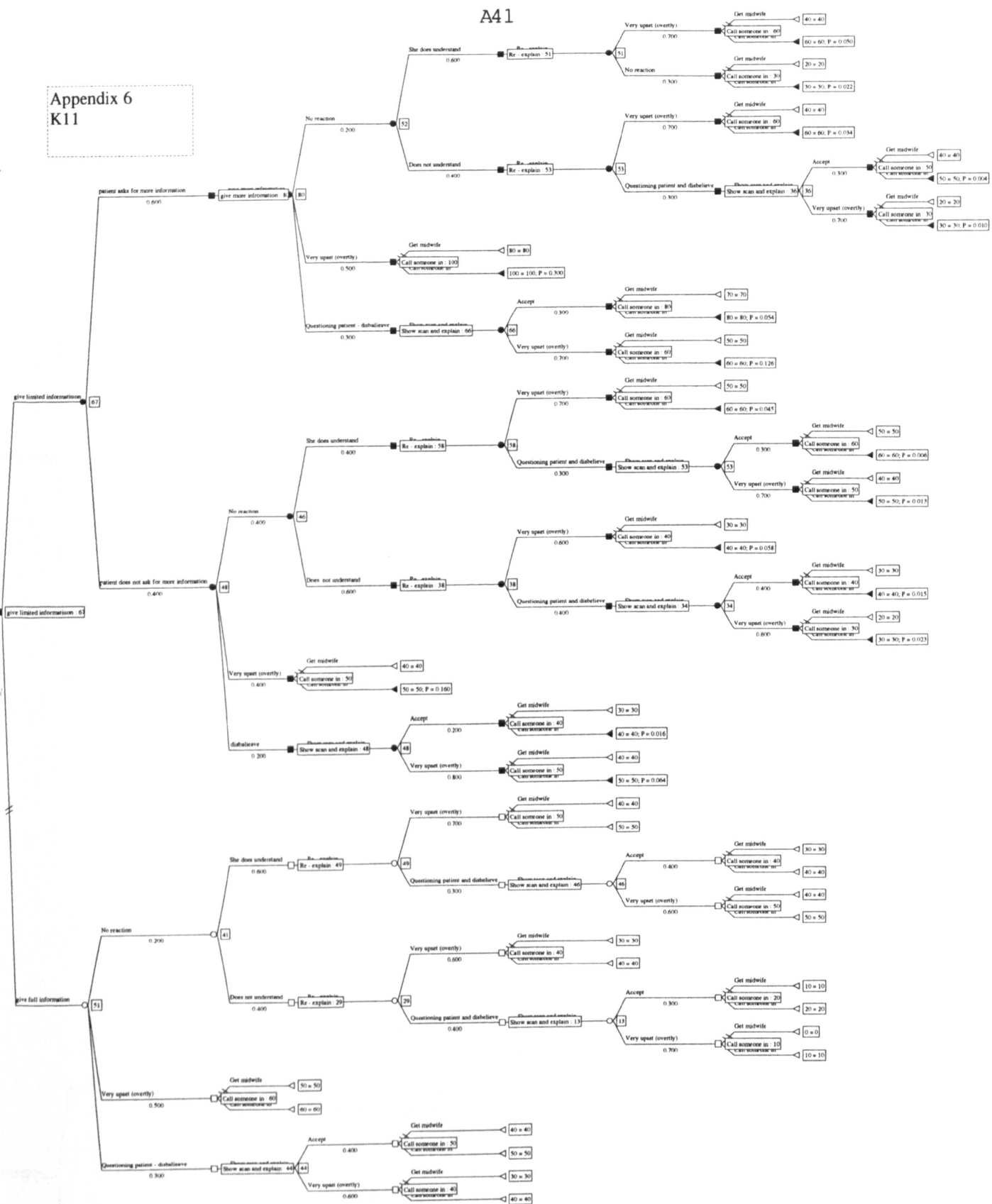


Appendix 6
K7

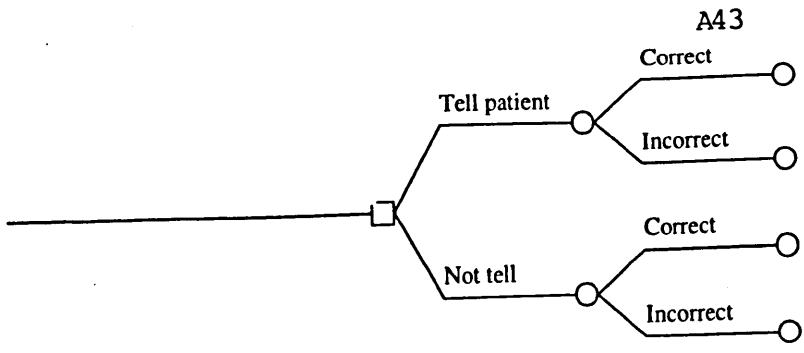
Appendix 6
K10



Appendix 6
K11

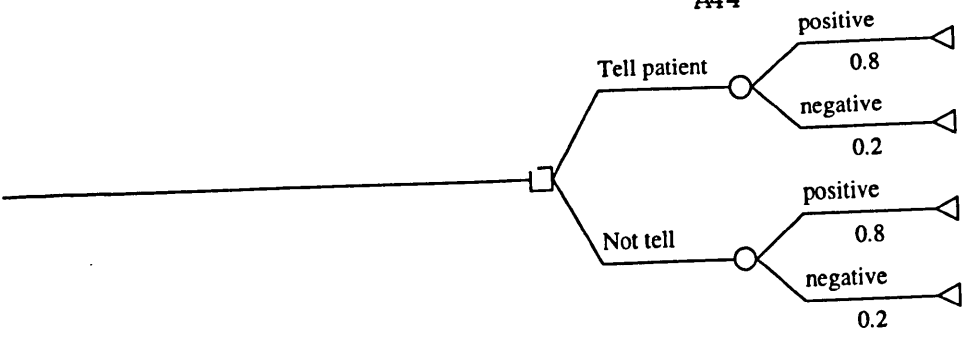


A43



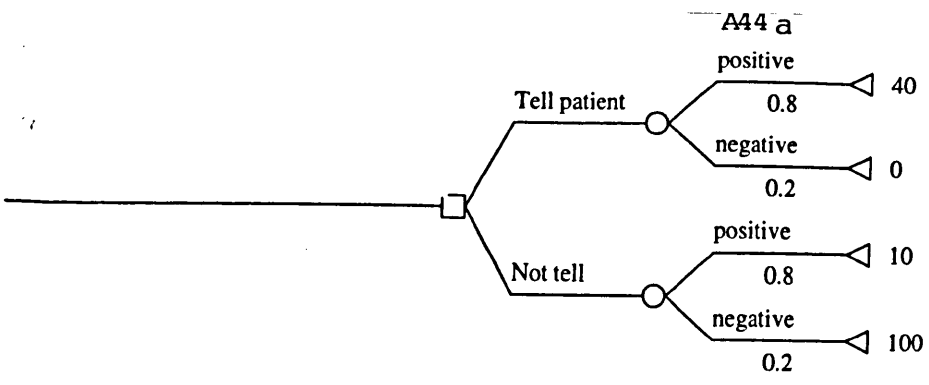
Appendix 7
S1

A44



Appendix 7

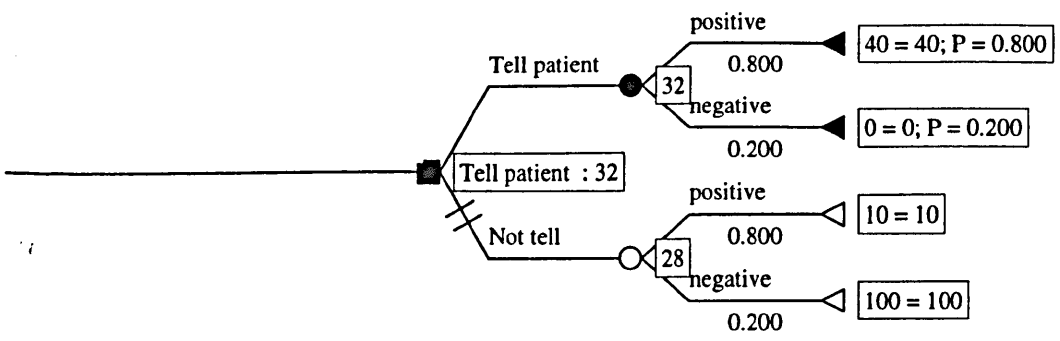
S2



Appendix 7

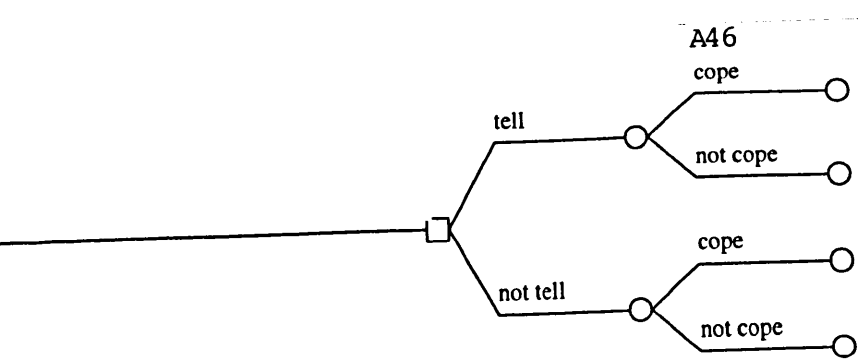
S3

A45



Appendix 7

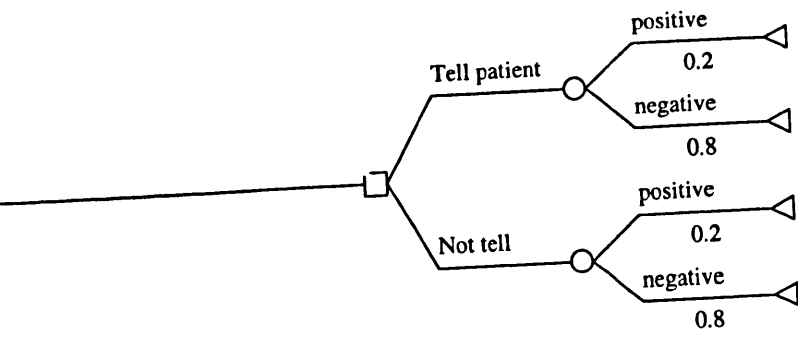
S4



Appendix 7

S5

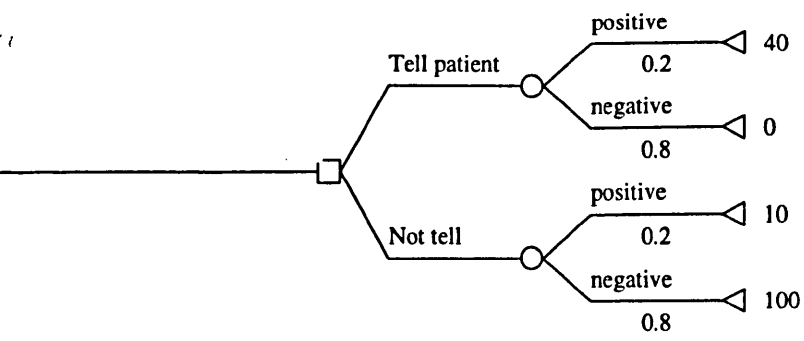
A47



Appendix 7

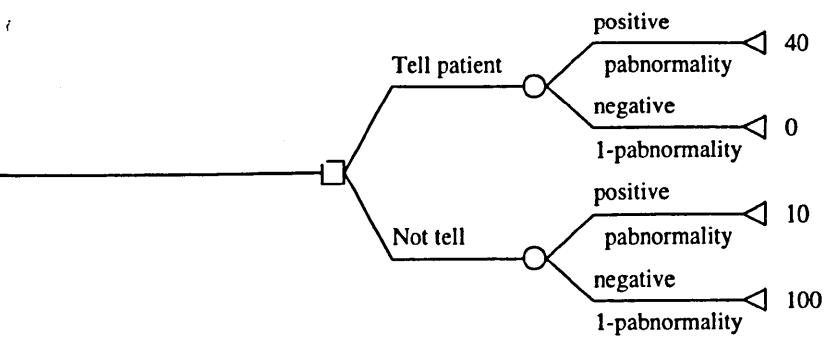
S6

A48



Appendix 7

S7



Appendix 7

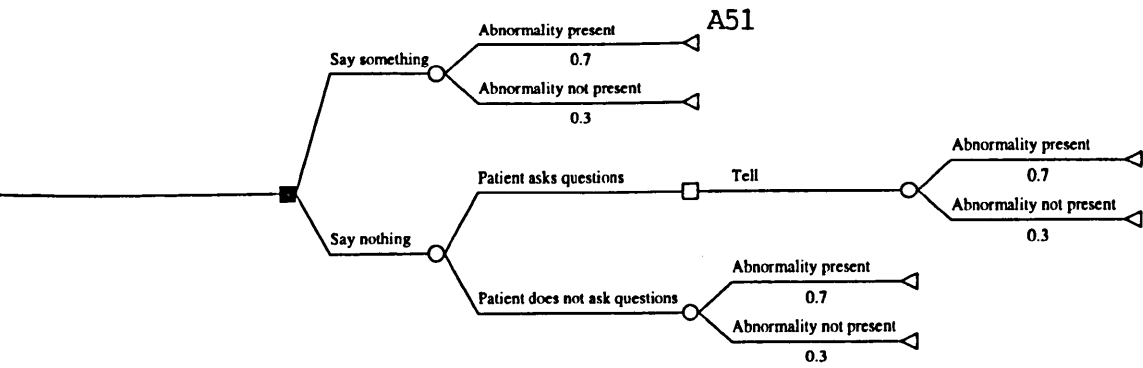
S8

A50

Say something

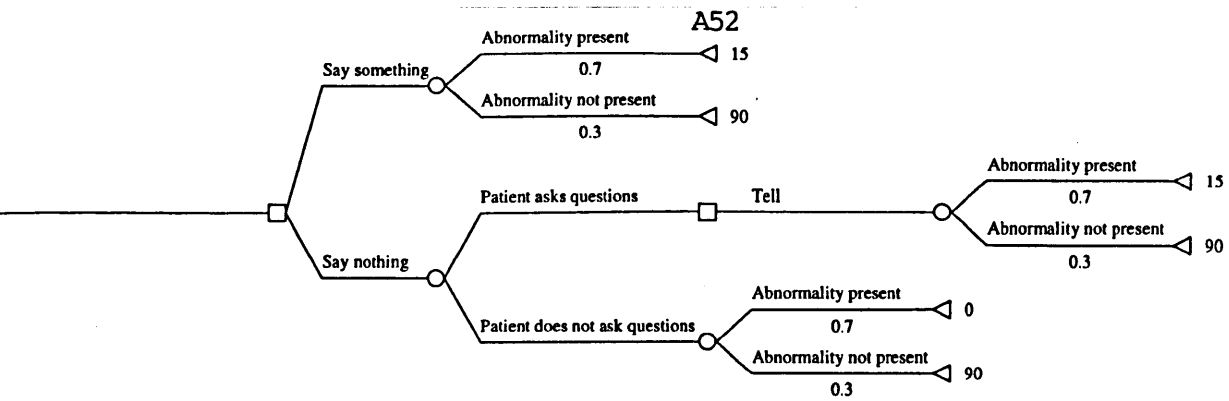
Say nothing

Appendix 8
H1



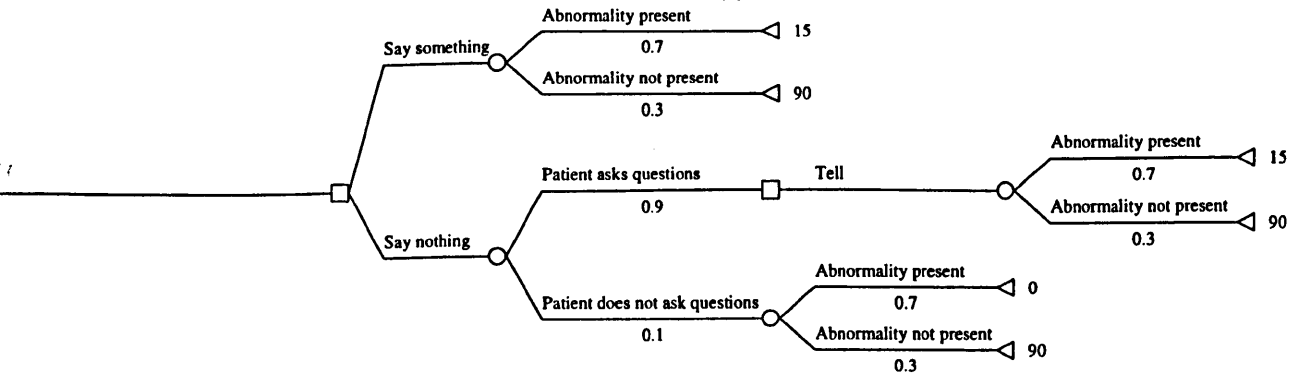
A51

Appendix 8
H2



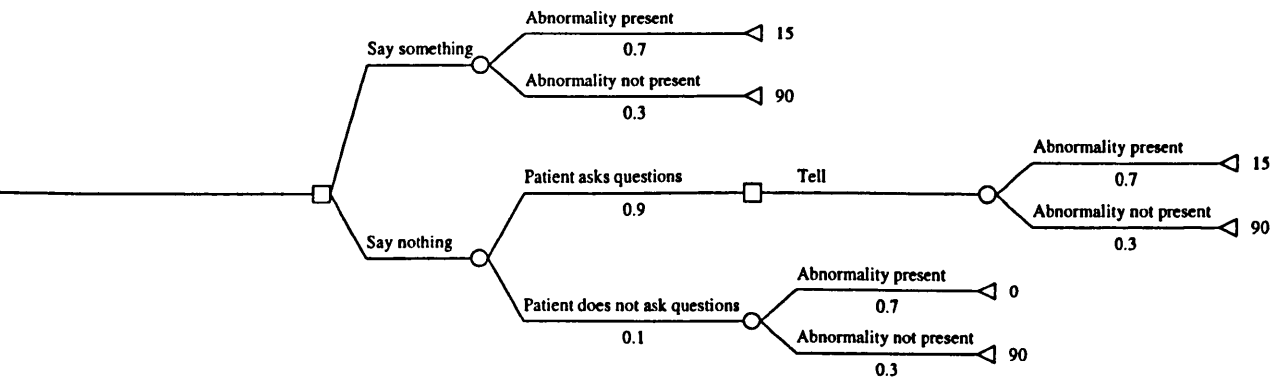
Appendix 8
H3

A53

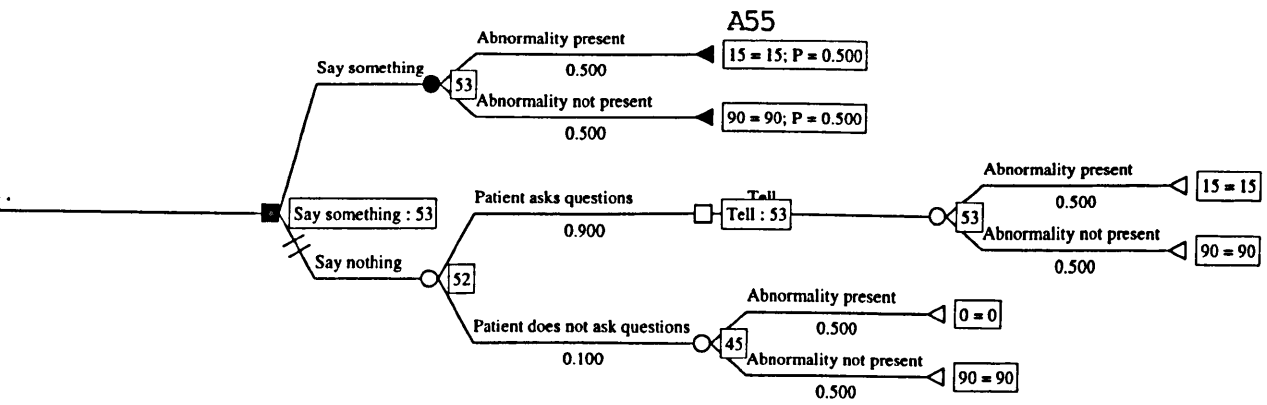


Appendix 8
H4

A54

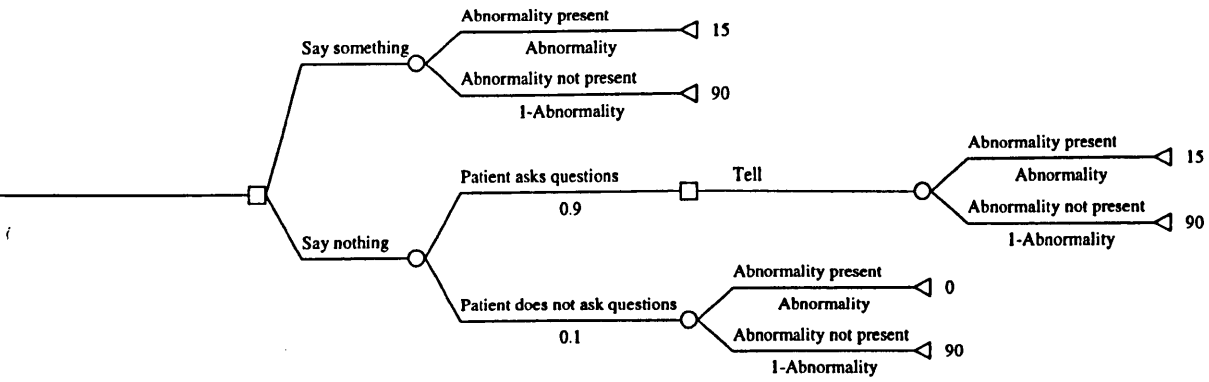


Appendix 8
H5



Appendix 8
H6

A56



Appendix 8
H7

Appendix 10

| | | | |
|---|------------|-----------|--|
| Hospital | | | |
| Date | | | |
| Type of Examination | | | |
| Judgement Observed | | | |
| Decision observed | | | |
| Decide to Repeat/not repeat Decide to use Red dot or not Decide on exposure factors Decide on appropriate equipment Decide on manner of communication Decide on which projections to take Judge patient condition | YES | NO | |
| Notes | | | |

Appendix 11

| | | | |
|--|------------|-----------|--|
| Hospital | | | |
| Date | | | |
| Type of Examination | | | |
| Judgement Observed | | | |
| Decision observed | | | |
| Decide on appropriate equipment Decide on manner of communication Decide on which projections to take Judge patient condition | YES | NO | |
| Notes | | | |

Appendix 12

Results from the survey

4.3.1 Return rates

| | |
|--|----------|
| Number of questionnaires sent to sonographers | 12 |
| Number of questionnaires returned from sonographers | 6 (50%) |
| Number of questionnaires sent to radiographers | 43 |
| Number of questionnaires returned from radiographers | 23 (53%) |

4.3.2 Results from sonographer questionnaire

1) *In your professional practice do you make decisions?*

YES 6 (100%)

NO 0 (0%)

2) *If the answer to 1 was YES, please give 2 examples of decisions that you make regularly in your professional practice:*

The decisions identified by sonographers in the survey were as follows:

- a) Judgements about missed abortion
- b) Decided whether a foetal heart is present
- c) Information to give the patient. (Four of the six sonographers identified this)
- d) Deciding if the scan is normal
- e) What follow up scans to recommend
- f) Decisions and judgements about foetal viability
- g) Decision about foetal normality
- h) Diagnostic decisions

3) *Do you evaluate the outcomes of the decisions that you make?*

- a) All the time 4 (66%)
- b) The majority of the time 0 (0)
- c) Sometimes 2 (33%)
- d) Never 0 (0%)

4) *Are you happy about the outcomes of the decisions that you make in your professional practice?*

- | | |
|-----------------------------|---------|
| a) All the time | 1 (17%) |
| b) The majority of the time | 4 (66%) |
| c) Sometimes | 1 (17%) |
| d) Never | 0 (0%) |

5) *Have you ever had any training/ information in decision making or judgement?*

YES 2 (33%) One respondent mentioned this had come in the DMU course.

NO 4 (66%)

6) *Do you think it would be useful to have some training/information in decision making and judgement?*

YES 6 (100%)

NO 0 (0%)

4.3.3 Results from radiographer questionnaire

1) *In your professional practice do you make decisions?*

YES 23 (100%)

NO 0 (0%)

2) *If the answer to 1 was YES, please give 2 examples of decisions that you make regularly in your professional practice:*

The decisions identified by radiographers in the survey were as follows:

- | | |
|---|----------------|
| a) Checking films for technical quality | (10 responses) |
| b) Working with other departments | (3 responses) |
| c) Which views to undertake in a particular examination | (13 responses) |
| d) Dealing with patients | |
| e) Organisation of workload | (10 responses) |
| f) Whether to call in the second on call | |
| g) Whether to query unreasonable requests | |

- h) How much information to tell the patient
- i) When to put on a red dot
- j) "As a result of problem solving"
- k) "Whether to do cc's"
- l) "What density to set as regards to the test film"
- m) "Patient day to day management"

3) *Do you evaluate the outcomes of the decisions that you make?*

- | | |
|-----------------------------|----------|
| a) All the time | 5 (21%) |
| b) The majority of the time | 10 (43%) |
| c) Sometimes | 8 (34%) |
| d) Never | 0 (0%) |

4) *Are you happy about the outcomes of the decisions that you make in your professional practice?*

- | | |
|-----------------------------|----------|
| a) All the time | 0 (0%) |
| b) The majority of the time | 21 (91%) |
| c) Sometimes | 2 (9%) |
| d) Never | 0 (0%) |

5) *Have you ever had any training/ information in decision making or judgement?*

YES 8 (40%)

NO 14 (60%)

One respondent crossed this section out and wrote "EXPERIENCE"

6) *Do you think it would be useful to have some training/information in decision making and judgement?*

YES 21 (91%)

NO 2 (9%)

One person that answered NO was also the one that had answered "EXPERIENCE" in response to question 5.

The other radiographer who gave a NO response also gave a response to question five that indicated that they had not had any training or information regarding decision making.

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