Community Nurses'
Judgement and Decision Making
for the Management of Venous Leg Ulceration

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Abstract

Management of leg ulceration is an important part of community nurses' workload but previous evidence suggests the quality of diagnosis and treatment of venous leg ulceration may be below that which should be expected.

This thesis uses Judgement Analysis and Think Aloud methodologies to explore the performance of 18 tissue viability specialist nurses and 18 generalist community nurses managing patients with leg ulceration. The nurses made diagnostic judgements and treatment choices and assigned confidence ratings on 110 clinical scenarios generated from real patient cases. These were presented online, as written scenarios, and using photographs of wounds to add visual information. Data for the judgement 'ecology' was derived from consensus judgements of a group of 'expert' nurses using the same scenarios. Logistic regression models were constructed to examine ideographic Lens Model statistics for individual nurses. Comparisons were made between groups of nurses with different levels of education and expertise. Think Aloud data from three generalist nurses was analysed to identify their cognitive processes.

The results showed that clinical decisions and judgements about venous leg ulceration are made in uncertain decision environments. In this study, community nurses achieved levels of accuracy below the achievable levels of judgement accuracy indicated by the diagnostic and treatment ecology models. Education alone was not a predictor of superior clinical performance. The ABPI was an important but under-weighted cue in diagnosis and the diagnosis (as a cue) was an important but under-weighted cue in treatment choice. Despite high levels of experience, nurses were under-confident in their judgements. A range of cognitive approaches to reasoning were apparent.

The main contribution of this thesis is exposing the complexity of the clinical environment for leg ulceration and in setting out models for diagnostic judgment and treatment choices for venous leg ulceration. These models provide a starting point for developing robust strategies for supporting community nurses' judgement and decision making.

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Thank you.

Author's Declaration

This thesis is a presentation of my original research work and effort and has not been submitted anywhere for any award. To the best of the candidate's knowledge, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis. Where other sources of information have been used, they have been acknowledged.

Una Adderley

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CHAPTER 1

INTRODUCTION

Healthcare professionals make clinical judgements and clinical decisions as a normal part of their working lives. In general usage, the terms 'judgement' and 'decision' are often used interchangeably, but when applied to the clinical setting, clinical judgements have been defined as "an assessment between alternatives" while clinical decisions have been defined as "a choice between alternatives" (Dowie, 1993, p8). Therefore, the term 'clinical judgement' will often relate to patient assessment and diagnosis while the term 'clinical decision' will relate to choosing the most appropriate action (such as a treatment) to achieve a desired outcome. Clinical judgement and decision making is complex since it will be based on uncertain information applied to widely varying clinical situations. Errors and sub-optimal judgements and decisions will occur but good clinical judgement and decision making should minimise the risk of avoidable errors and increase the chances of achieving desirable outcomes.

Nursing practice is characterised by assessing and monitoring the condition of the patients, identifying significant changes and initiating interventions to promote desirable outcomes (Lamond et al., 1996a, Thompson et al., 2000b, Thompson et al., 2004). Therefore, nurses are responsible for making clinical judgements about the patients in their care and clinical decisions about the most appropriate interventions. In recent years, the development of the role of the nurse has meant that nurses have taken on greater levels of responsibility and independence for clinical judgement and decision making. Technological advances such as telemedicine and new diagnostic tools have required nurses to develop new areas of knowledge and skills while the introduction of nurse prescribing and nurse consultants posts has encouraged the expansion of the nurse's role (Department of Health, 1999b, Department of Health, 1999a).

Community nurses have a particularly high level of autonomy and independence since they usually deliver care as a solo clinician, albeit as a member of a larger nursing and multi-disciplinary team. District Nurses and Health Visitors were the first group of nurses to be permitted to prescribe although subsequently this has been extended to other areas of nursing (Department of Health, 1999b). Community nurses are required to have knowledge and skills relating to a wide range of diseases and conditions but

wound care and the management of leg ulceration in particular, remains a significant proportion of the workload for community nurses (Srinivasaiah et al., 2007).

Leg ulceration can be due to a number of causes including venous and/or arterial insufficiency. Although a reasonable evidence base exists to guide care regarding diagnosis and treatment of leg ulcers due to venous insufficiency (Royal College of Nursing, 2006) audit studies suggest that the management of venous leg ulceration may not be reaching the levels of care that should be achievable (Srinivasaiah et al., 2007, Royal College of Nursing, 2008, Vowden and Vowden, 2009). Sub-optimal care will have an adverse effect on patients' quality of life as well as increasing the cost of care to the NHS. Greater understanding of how community nurses make clinical judgments and decisions about managing venous leg ulceration would support the development of interventions to optimise the standard of care. It also has the potential to provide an exemplar of one area of care which might usefully shed light on other clinical nursing fields.

In this thesis, I explore how community nurses use the available information to make clinical judgements and decisions about managing leg ulceration. I seek to discover the level of accuracy that community nurses achieve and the level of confidence associated with those judgements and decisions. The impact of expertise will be considered and the cognitive processes that are used by community nurses in their clinical judgement and decision making will be identified.

Chapter 2 provides a background to the thesis. I discuss the impact of clinical uncertainty on clinical judgement and decision making and argue that evidence-based care offers a means of reducing clinical uncertainty. The pathophysiology, epidemiology and impact of venous leg ulceration is described and the evidence base for the diagnosis and treatment of venous leg ulceration is critiqued. I argue that the existence of this evidence allows an evidence–based approach to the management of venous leg ulceration but that audit evidence suggests that the quality of care that is being delivered may be sub-optimal. I propose that understanding the judgement and decision making processes of community nurses would shed light on this area of clinical practice.

Chapter 3 explores the evidence base for clinical judgement and decision making for nursing in general and with particular reference to community-based nursing care of leg ulceration. The types of judgements and decisions made by nurses are described. The evidence about the cognitive approaches of nurses is considered within the context of the theories of judgement and decision making and the factors that affect nurses' judgements and decisions are outlined. I argue that there is a lack of robust evidence about how nurses make judgements and decisions and that although a wide range of influencing factors have been identified, it is unclear how these are used in the management of venous leg ulceration. I propose that unpacking how community nurses manage the complexity of leg ulcer management would be useful for informing the development of approaches to promote optimal care.

Chapter 4 describes Judgement Analysis which is the chosen methodology for this thesis and justifies why this approach has been chosen over other possible alternative approaches. This chapter also describes and justifies the selection of Think Aloud techniques as an adjuvant methodological approach which is used alongside Judgement Analysis.

Chapter 5 presents the research methods used in this thesis. It presents the study design, the construction of the Judgement Analysis task, the rationale for the selection of the cues, the sample size for the judgement profiles, the sampling for the judgement scenarios and the methods of data collection from the nurse informants. It also presents the methods of data management and data analysis.

Chapter 6 introduces the results of the thesis. It describes the demographic characteristics of the nurse participants and the information on which they based their judgements and decisions.

Chapter 7 presents the results regarding the nurse participants' diagnosis of venous leg ulceration, including the nurses' use of the available cues and the accuracy of their diagnostic judgments. Where possible, comparisons are made between groups of nurses with different levels of expertise. The cognitive approaches used by the nurses in relation to their diagnostic judgements are described.

Chapter 8 presents the results regarding the nurse participants' treatment choices as to whether or not to apply high compression to an ulcerated leg. The nurses' use of the

available cues and their levels of accuracy is examined. Where possible, comparisons are made between groups of nurses with different levels of expertise and the cognitive approaches used by the nurses in relation to their treatment judgements are described.

Chapter 9 discusses the research findings of the thesis within the context of the current literature. The results in relation to the diagnosis and treatment of venous leg ulceration are considered along with the cognitive approaches that were evident in this study. An overview of the impact of expertise is offered. The strengths and weaknesses of the research design are evaluated and the implications for clinical practice and future research and the contribution of this thesis to research knowledge are outlined.

CHAPTER 2

BACKGROUND TO THE THESIS

2.1. Uncertainty in clinical practice

It is the responsibility of clinicians to make judgements and decisions that ensure that patients are offered high quality clinical care that improves quality of life and makes the most effective use of NHS resources. 'High quality clinical care' has been described as doing the right things at the right time to the right person (Muir Gray, 2001) but it is not always clear what 'the right things' or 'the right time' or even who 'the right person' is. The quality of care depends on how clinicians assimilate biological factors associated with the clinical condition along with social and individual preferences and ethical and moral considerations in their delivery of patient care (Donabedian, 2003). Clinicians are required to make a wide range of types of judgements and decisions (Thompson et al., 2000a) regarding issues where there is uncertain information upon which a variety of factors impact and where the 'optimal' outcome may vary depending on the perspective of the individual. Clinical uncertainty is an inevitable aspect of clinical practice.

Fox proposes that there are three basic types of clinical uncertainty:

1. uncertainty due to the impossibility of mastering the complete and constantly emerging volume of knowledge and skills that comprises current clinical knowledge,

2. uncertainty that stems from the gaps and limitations of the current clinical knowledge base,

3. uncertainty that is connected with distinguishing between the individual's lack of knowledge and skills and the absence of clinical knowledge to inform decision making (Fox, 2000).

Eddy described judgement and decision making as a chain between the patient's actual condition and treatment where every link is weakened by "uncertainty, biases, errors and differences of opinions, motives and values" (Eddy, 1996, p308). The judgement and decision-making process links raw data (such as the patient's symptoms and the research for clinical interventions) with outcomes (such as healing or reduction in pain).

Clinical judgement and decision making when developing a package of care for an individual patient is complicated by uncertainties around diagnosis, treatment options, the patient's preferences and the preferences of the clinical team (Eddy, 1988). Diagnosis can be complicated by uncertainty about what constitutes a certain condition. Although textbooks and national guidelines may exist to inform judgement, this guidance may be mostly based on consensual clinical opinion, rather than being underpinned by robust epidemiological evidence. Furthermore, the diagnostic signs and symptoms may not be exclusive to one particular disease or condition; some of the agreed signs and symptoms may not be present in all cases; or the condition may be complicated by concurrent disease. In particular, a large proportion of elderly patients will have multiple, on-going, chronic conditions (Colin-Thome and Belfield, 2004). In the absence of a definitive diagnostic test, nurses will adopt individual diagnostic strategies to manage this uncertainty. These judgement strategies may vary in accuracy and be affected by clinical experience, knowledge or education (Thompson, 1999b, Van Hecke et al., 2008). Nurses with differing levels of experience in measuring and monitoring clinical signs and symptoms may vary in the accuracy of their observations and their confidence regarding the significance of those observations (Kaiser et al., 1999, Yang and Thompson, 2011). There will also be uncertainty associated with the use of diagnostic tests. No test is completely reliable since all have false negatives and false positives. Furthermore, nurses will vary in their skill in selecting appropriate clinical investigations, carrying them out and interpreting the results.

Uncertainty about diagnosis may also be related to issues relating to communication between the patient and the nurse. Health problems such as deafness or dysphasia resulting from a stroke may impede communication between the patient and the nurse, or a patient may choose to under-report their level of pain. Nurses will also possess varying levels of communication skills and coping strategies that may impact on communication during assessment and treatment. For example, some nurses will be more perceptive than others at noting subtle changes in diagnostic cues such as patients' facial expressions or body language in relation to pain. In contrast, it has been suggested that nurses may use social defences such as 'distancing' and 'denial' to protect themselves from being emotionally overwhelmed, for example by the pain they

are inflicting on their patients during assessment or treatment interventions such as dressing changes (Krasner, 1995, Briggs, 2006).

Uncertainty will also affect clinical decision making about treatment. The evidence base for the outcomes of interventions may be patchy, inconclusive or non-existent. Even when the diagnosis is obvious and robust evidence exists to guide decision making, the diagnosis is only one of the cues that a nurse will consider in such judgements. Other cues, such as patient preferences or costs (Adderley and Thompson, 2007) will impact on the decision to varying degrees. Nurses' individual decision making strategies may vary in competence and be affected by clinical experience, knowledge or education. Finally, apparently similar patients will respond in different ways to the same intervention and each patient will have their own individual set of values and preferences (Eddy, 1996). All these factors will contribute to the irreducible uncertainty (Eddy, 1990) that surrounds clinical decision making.

2.2. Evidence-based care in nursing practice

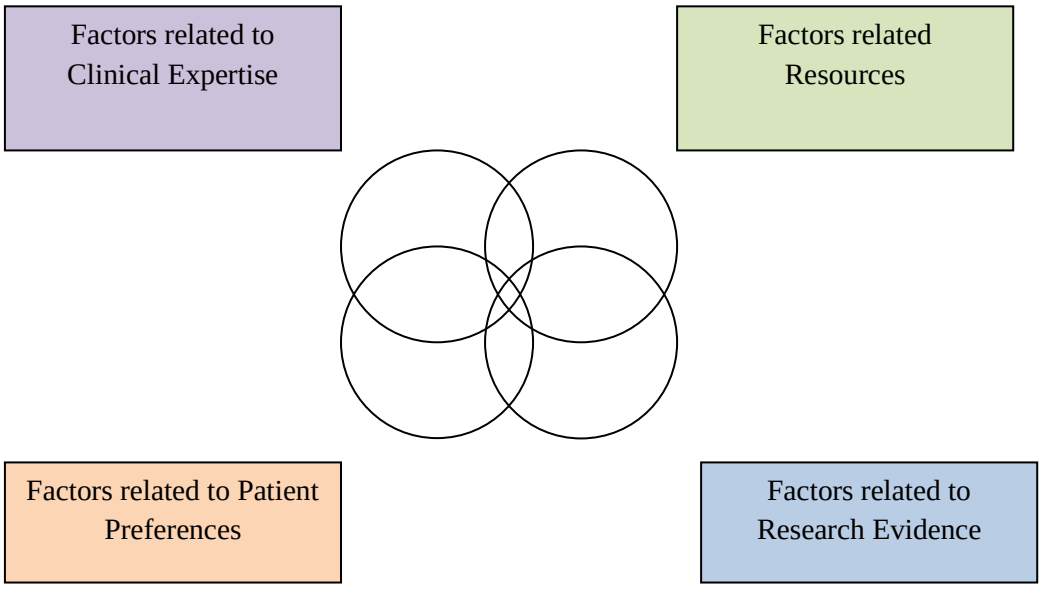
The uncertainty inherent in clinical practice means that clinical judgment and decision making is a complex cognitive process. Given the same patient or clinical scenario, different nurses, however well-intentioned, may come to different conclusions since there are many opportunities for errors (Eddy, 1996). Clinical uncertainty cannot be eliminated since many of the sources of uncertainty are individualised, difficult to predict or impossible to eradicate. High quality research evidence can help clarify this uncertainty but, at best, care based on research can only lead to better outcomes *on average* since study results reflect the study population as opposed to the individual patient.

Evidence-based care is an approach that goes beyond simply providing care that is in line with the current research findings. Evidence-based care is about incorporating the best available research alongside consideration of clinical expertise, patient choice and health care costs (Dickersin et al., 2007). The underpinning hypothesis of such evidence-based care is that "convincing information leads to optimal decision making" (Grol, 2001, p2579). Defining 'optimal care' is complex since measuring the quality of patient care can be approached from many perspectives with differing sets of values

(Grol, 2001). One model for evidence-based clinical decision making (Fig.2.1) notes four components that each contribute to the evidence-based decision (DiCenso and Cullum, 1998) but the value placed on each component will inevitably vary depending on the perspective of the decision maker.

Figure 2.1. A model for evidence-based decision making

(DiCenso and Cullum, 1998)



For example, the nurse delivering care may define 'optimal' principally in terms of offering care that is in line with research findings regarding the effectiveness of certain interventions. By contrast, their manager may define 'optimal' principally in terms of minimising cost while the patient's definition may be principally in terms of their own physical comfort.

Critics of evidence-based care have argued that it is a scientifically biased approach to clinical decision making that implies a misleading certainty which can have a detrimental effect on clinical practice. One approach to simplifying clinical complexity is through focussing on the achievement of a key clinical outcome. For example, when treating cancer the length of time that life can be extended may be seen as the most important clinical outcome. However, some patients may value quality of life over

length of life. Good evidence-based care should consider all the potentially relevant clinical outcomes and deliver care that meets the individual patient's preferences.

The natural variation found within the patient population leads to uncertainty in clinical judgement but there is some evidence to suggest that judgements and clinical decisions that are more closely in line with evidence-based guidelines are more likely to benefit patients and healthcare providers (Thomas et al., 2009). Nurses who are aware of the relevant areas of uncertainty will have more realistic expectations as to the likelihood of a certain decision leading to a particular outcome (Thompson et al., 2004) and there is general consensus that is makes sense to start with what is known (Reilly, 2004). The existence of good quality research evidence enables clinical decision making to be better informed and potentially reduces the level of uncertainty (Thompson et al., 2004). Thus, wherever possible, information from good quality research provides the most appropriate starting point in the clinical judgement and decision making process for the individual patient as such knowledge is more reliable than that derived from unsystematic clinical experience alone (Guyatt et al., 2002). The view of both the government and the nursing profession supports this approach (Nursing and Midwifery Council, 2008, Department of Health, 2008). Research evidence may not exist to guide all facets of clinical care but when it does, it provides an opportunity for informed action which offers the most appropriate starting point in the clinical decision making process.

2.3. Venous leg ulceration

Venous leg ulceration is a chronic condition that has been defined as "an open sore in the skin of the lower leg due to high pressure of the blood in the leg veins" (British Association of Dermatologists, 2008). Venous leg ulceration occurs when venous circulation is compromised by failures within the deep, superficial or perforator vein systems that enable venous return from the feet and legs. These systems contain valves that allow blood to flow up toward the heart and prevent back flow down the leg. Blood flows towards the heart in response to increased pressure from the pumping of the heart combined with the calf and foot pump mechanisms which function when the ankle is

flexed and during walking. The valve systems prevent backflow as shown in Figures 2.2 and 2.3 (Morison and Moffat, 1997).

Figure 2.2. Healthy valves prevent backflow of blood from the deep to the superficial veins

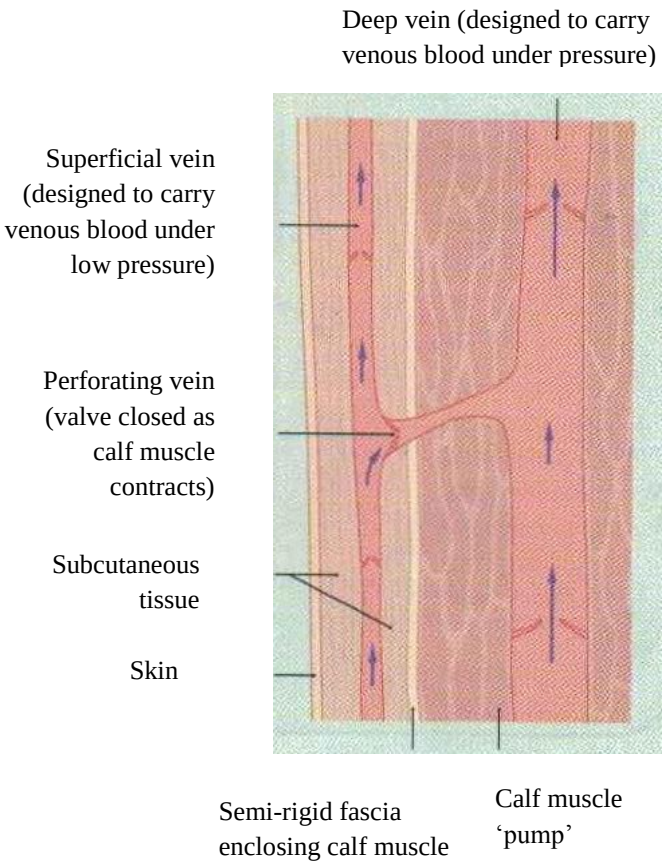
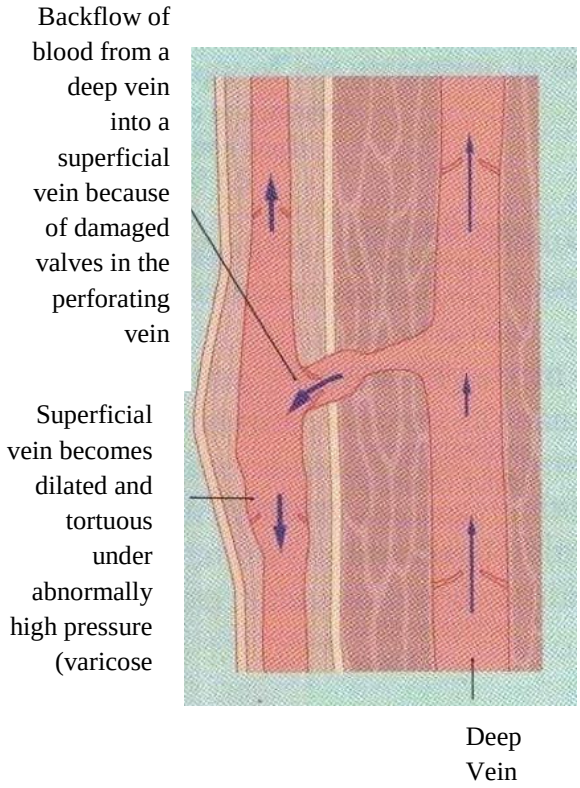


Figure 2.3. An incompetent valve in a perforating vein allows backflow of blood from the deep to the superficial venous system



(Adapted from Morison et al 1997)

Some people are born with poor valves while others acquire valve damage following venous thrombosis (a blood clot that forms within a vein) or traumatic injury to the veins. Venous hypertension can also occur as a result of aging or reduced mobility due to illness or occupation. Faulty valves allow the backward flow of blood down the leg which leads to increased pressure within the veins. The exact mechanism by which the ambulatory venous hypertension results in vulnerable skin is uncertain (Morison and Moffat, 1997) but eventually, the skin may spontaneously break down or fail to heal following an injury. The resulting open lesion is known as a venous leg ulcer.

2.3.1. The impact of venous leg ulceration

Leg ulceration affects a large number of UK residents. Population-based point prevalence studies (the number of patients with open ulceration) estimate that between 0.12% and 1.1% of a population will have an open ulcer at any time (Graham et al., 2003, Posnett and Franks, 2007). However, leg ulceration is a recurring chronic condition and overall prevalence studies (the number of patients with open and healed leg ulceration) estimate that between 0.6% and 3.6% of the population will experience leg ulceration at some point in their lives (Graham et al., 2003).

In recent UK prevalence studies that considered all leg ulcers, venous disease was the most common aetiology. A national guideline lists the diagnostic signs and symptoms of venous leg ulceration but the evidence base for these is poor so there is likely to be uncertainty about the accuracy of prevalence figures for venous leg ulceration. Doppler-aided assessment of ankle brachial pressure index (ABPI) is an investigative assessment that is used to assess arterial supply to the lower leg. The guideline proposes that an ABPI of below 0.8 should be considered indicative of the presence of arterial disease which would differentiate between an 'uncomplicated' venous leg ulcer and a venous leg ulcer that is complicated by significant arterial disease (Royal College of Nursing, 2006). However, there is still uncertainty about what constitutes 'significant' arterial disease. Textbooks suggest that an ABPI between 0.5 and 0.8 indicates mild to moderate peripheral arterial disease while an ABPI below 0.5 suggests severe arterial impairment (Morison and Moffat, 1997, Doughty et al., 2000) but universally accepted definitions do not yet exist. The same guideline suggests that an ABPI above 1.0 might prompt referral to a medical specialist but notes that this may vary according to local referral protocols. An ABPI above 1.2 has been regarded as a possible indicator of arterial disease and thus a contraindication to the application of high compression (Morison and Moffatt, 1994, Morison and Moffat, 1997, Iglesias et al., 2004) but no clinical evidence has been found to demonstrate the utility of this as a cut-off point. This uncertainty about the diagnosis of arterial disease means that the accuracy of prevalence figures for arterial and mixed aetiology ulcers is also likely to be uncertain.

Uncertainty also arises from the design of prevalence studies (Firth et al., 2010). Studies which rely on health professional reporting will report the burden of healthcare rather than the burden of disease as there is evidence to suggest that many patients with

leg ulceration self-manage their condition without contact from health services (Nelzen et al., 1996). Therefore, studies which use self-reporting are more likely to capture most patients with leg ulceration. However, although misdiagnosis may occur in any prevalence study, studies which use patient self-reporting are at greater risk of high false positive and false negative risks. One early prevalence study which conducted retrospective validation of the patient-reported diagnoses of leg ulceration found notable false positive (40%) and false negative rates (6%) (Dale et al., 1983). Some ulcers which had been reported as venous leg ulcers were in fact varicose eczema, while others were actually stomach ulcers! Although this study is thirty years old, a more recent review of design and reporting issues in self-reported prevalence studies (Firth et al., 2010) found false positive rates of between 40%-53% which suggests that there is still a significant level of misreporting of diagnoses. Differences in diagnostic criteria, the age parameters for inclusion in a study and sampling techniques will also have an impact on the reliability, validity and generalisability of the results (Graham et al., 2003, Firth et al., 2010).

Table 2.1 shows the results of the UK prevalence studies.

Table 2.1. UK Leg Ulcer Reported Diagnoses

Author	Date	Source*	Proportionate Distribution (%)			
			Venous	Arterial	Mixed	Other / Don't know
Callam et al	1987	C & H	85	3	12	-
Cornwall et al	1986	C	52	9	22	-
Srinivasaiah N et al	2007	C & H	38	12	12	38
Vowden and Vowden	2009	C & H	40	13	11	36

Source* C = Community, H = Hospital

All the studies used health professional reporting rather than self-reporting, so probably under-estimate the extent of prevalence. All the studies sought to identify all the patients using a wide range of community based health care providers, but three studies also sought to identify hospital in-patients with leg ulceration. As more people with leg

ulcers receive community-based healthcare than hospital care (Cornwall et al., 1986) this approach increases the validity of the data. The reported diagnoses of one study were retrospectively checked by the researcher which reduced the risk of misdiagnosis (Cornwall et al., 1986). The diagnoses of another study (Callam et al., 1987) were not independently checked by another health care professional but they were based on a highly structured, evidence based assessment which included a full medical history (with specific questioning for arterial events), clinical examination and Doppler assessment of ABPI for each participant ; this increased the chances of accuracy. In two other studies (Srinivasaiah et al., 2007, Vowden and Vowden, 2009) which reported a much higher prevalence of arterial ulceration, the diagnoses were those recorded in the patients' notes and no information was reported about the diagnostic assessment process underpinning these diagnoses. Therefore, it is not possible to assess how likely it is that these diagnoses are accurate.

The Srinivasaiah et al (2007) and Vowden and Vowden (2009) studies reported leg and foot ulcers together as one population, so the inclusion of foot ulcers in these ulcer populations increased the proportional prevalence of arterial leg ulceration. Two surveys also found that a significant proportion of leg ulcers had been diagnosed as 'other / don't know' (Salaman and Harding, 1995, Srinivasaiah et al., 2007, Vowden and Vowden, 2009). Other aetiologies (such as pyoderma gangrenosum and tropical ulcers) can cause leg ulceration, but there is currently no robust prevalence data for such conditions (although they are thought to be relatively rare accounting for 5% or less of leg ulceration (King, 2004)). It is likely that the majority of the 'other / don't know' group had ulceration due to more common aetiologies which had not been diagnosed with only small proportion of ulcers due to the more unusual conditions.

Taken overall, the results of these prevalence studies provide very broad and potentially flawed estimates for the proportion of reported ulcer diagnoses. It is likely that uncomplicated venous leg ulceration accounts for 38% -85% of all leg ulceration in the UK, arterial leg ulceration for 3%- 13%, underlying mixed venous/ arterial pathophysiology for 8% - 22% and unusual underlying pathophysiology for around 5%.

Leg ulceration is more common in old people, with chronic venous hypertension being seven times more prevalent in 60 year olds than 20 year olds (Cornwall et al., 1986). A survey of 600 patients with leg ulceration found arterial disease in association with leg

ulceration increasing from no instances in those under 40 years old to 50% in the "very elderly" (which was not defined in terms of years) (Callam et al., 1987). Leg ulceration appears to be more common in women than men (Callam et al., 1987) although this may be related to the longer life expectancy of women. A meta-synthesis of qualitative research also found a growing body of trustworthy and credible qualitative research evidence into the experience of having venous leg ulceration. This evidence shows that venous leg ulceration can have a profound negative impact on quality of life in terms of pain, malodour and leakage, impaired mobility, anxiety, sleep disturbance and social isolation (Briggs and Flemming, 2007).

Leg ulcer care is costly for the NHS (Posnett and Franks, 2008). In the UK between £2.3 - 3.1 billion is spent on chronic wound care while costs for leg ulcer care are estimated to be between £168 - £600 million per year, most of which is borne by NHS community services (Nelzen, 2000, Posnett and Franks, 2008). A randomised trial of bandaging for healing venous ulceration (which included an economic evaluation) found the biggest proportion of cost was for nursing time (Iglesias et al., 2004). This study was used as the basis for estimating the cost of UK venous leg ulcer management (Posnett and Franks, 2007). However, trial care may be more expensive in terms of care inputs (such as nursing time and dressing or bandaging costs) but less expensive if better healing rates are achieved. Alternatively, care outside a trial environment, may be less expensive in terms of cost of inputs or more expensive in terms of poorer outcomes (such as lower healing rates). Therefore, the trial-based estimates for the cost of leg ulcer care may over or under estimate costs.

2.3.2. The evidence base

Evidence for diagnosis

Accurate diagnosis is the foundation of any treatment decision. Ideally diagnostic criteria should be established by research studies which recruit patient samples that are representative of patients with the disorder, which use an appropriate definitive diagnostic standard, and which carefully and consistently seek and classify clinical manifestations (Richardson et al., 2002). Diagnostic tests are developed to assist the diagnostic process through providing a means by which a suspected diagnostic

judgement can be confirmed or disproved. Ideally, a diagnostic test should be simple to use, low cost and sufficiently sensitive to detect those with the condition but sufficiently specific to correctly exclude those without the condition. An effective diagnostic test increases the accuracy of diagnosis, which helps in the selection of the appropriate treatment and thus should lead to better outcomes. The accuracy of diagnostic tests should be confirmed through research which uses a representative patient sample and which blindly compares the test against an independent gold standard (Jaeschke et al., 2002).

National guidelines (CREST, 1998, SIGN, 1998, Royal College of Nursing, 2006) indicate that venous leg ulceration should be diagnosed by the presence of signs and symptoms known to be associated with venous disease and believed to be indicative of venous leg ulceration (Table 2.2). However, most of these recommendations are based on expert opinion rather than studies of acceptable quality, or even multiple studies with weak or inconsistent results or single studies of poorer quality (Royal College of Nursing, 2006). No robust evidence exists to support the positive identification of venous leg ulceration through clinical history or physical examination. There are a range of diagnostic tests for the positive identification of venous insufficiency. Duplex scanning is a non-invasive procedure that can produce images of the blood flow through the vessels of the legs, thereby identifying any reflux or obstructions as well as being capable of measuring valve closure times. Other diagnostic tests exist such as venography (an invasive technique involving the injection of radiopaque dye into the veins), tourniquet testing (a non-invasive technique involving the application and release of tourniquets to assess the distension of the superficial veins) and Doppler ultrasound to listen for venous reflux. However, Duplex imaging has become the standard diagnostic approach for assessing venous disease. It is considered the gold standard diagnostic test against which other tests are measured (Doughty et al., 2000) but requires expensive non-portable equipment and highly skilled clinicians so is not an option for use in the community.

Table 2.2 – Cues relevant to diagnosing uncomplicated venous leg ulceration as identified from the literature			**2006 RCN (2006)**	**SIGN (1998)**	**CREST (1998)**
Cue		**Evidence**			
Medical History	Venous Disease / Damage	Varicose veins	■	■	■
		Previous VLU			■
		Phlebitis	■		■
		Trauma in relevant leg	■		■
	Arterial Disease	Heart disease	■	■	■
		Stroke	■	■	■
		TIA	■	■	■
		Diabetes	■		
		Peripheral vascular disease	■	■	■
		Cigarette smoking	■		■
		Rheumatoid arthritis	■		
		Night cramps			■
		Rest pain in leg			■
		Intermittent claudication	■	■	■
Position		Gaiter area of leg	■	■	■
		Forefoot or heel			■
Clinical Appearance of lower limb	Visible signs of venous disease on lower limb	Eczema / dermatitis			■
		Ankle flare	■		■
		Varicose veins	■	■	■
		Lipodermatosclerosis	■		■
		Hyperpigmentation	■	■	■
		Atrophie blanche	■		■
	Visible signs of disease other than venous disease on lower limb	Hair loss			■
		Taut shiny skin	■		
		Gangrenous toes / tissue necrosis in lower foot	■	■	■
		Oedema			
		Dependent rubor	■		
		Pale or blue feet	■		
		Depth	■	■	■
		Punched out	■		■
		Poorly perfused wound bed	■		
		Rolled edge	■		■
		Cauliflower appearance			■
		Raised ulcer bed	■		
Pain	<pain - arterial	Pain scale score			
Age	Elderly	Date of birth – age in years		■	■
ABPI	<0.8 >1.2	Clinical test	■	■	■

An alternative approach to diagnosing venous ulceration is through the identification of the signs and symptoms thought to be associated with venous leg ulceration in conjunction with clinical tests in order to exclude other possible diagnoses. A significant proportion of people with open venous leg ulceration also have arterial disease (Callam et al., 1987). The application of compression (tight bandaging or hosiery which is the mainstay of treatment for venous leg ulceration) can dangerously compromise the arterial blood supply in patients with inadequate arterial flow (Doughty et al., 2000) so accurate screening of arterial disease is important.

Doppler-aided assessment of ankle brachial pressure index (ABPI) is an investigative assessment that is used to assess arterial supply. The ABPI is calculated by measuring the brachial and ankle arterial pressures (using a sphygmanometer and hand-held Doppler ultrasound) and then dividing the individual ankle pressures by the highest of the brachial pressures to give a ratio. There is some evidence to support the use of Doppler ultrasound to assess the arterial circulation of the lower limb to diagnose significant arterial disease and thus differentiate between leg ulceration uncomplicated by arterial disease and leg ulceration caused by or complicated by arterial insufficiency. Studies which have considered the relative accuracy of pedal pulse palpation compared to Doppler assessment of ABPI have consistently found Doppler assessment to be a more valid and reliable diagnostic approach for identifying arterial insufficiency. An early study compared the traditional diagnostic test of palpation of pedal pulses to detect arterial insufficiency with Doppler assessment of ABPI (Callam et al., 1987). The study examined 600 patients and found considerable correlation between the absence of pulses and the presence of arterial impairment, but also a significant level of false positive and false negative results. Some legs with impalpable pulses were found to have adequate arterial supply while some legs with palpable pulses did not. The reliability and validity of this study was increased through its highly representative and large patient sample, the use of a gold standard as the index test comparator (Doppler ultrasound), blinding to the index test result and the use of a single assessor to rule out inter observer variation (although this prevented reliability testing by comparing responses achieved by a different assessor).

A later study which also considered the palpation of pedal pulses, confirmed the unreliability of pedal pulses both in terms of variation between techniques and intra-

observer variation (Brearley et al., 1992). This study recorded the Doppler assessment of ABPI but the senior clinicians' opinions were assigned as the index test rather than the ABPI recording. Another study also found inter operator variation (Magee et al., 1992) but did not define an index test. The lack of a gold standard index, the much smaller and less representative samples and the uncertain blinding mean that the results of these studies must be open to question, although they do confirm the unreliability of pedal pulse palpation in terms of inter operator variation. Doppler assessment of ABPI appears to offer the more valid and reliable diagnostic test for assessing the level of arterial sufficiency, but there is evidence to suggest that there are many factors that can affect the accuracy of a Doppler ultrasound assessment, particularly with regard to the operating clinician's level of skill and expertise (Kaiser et al., 1999, Keen, 2008).

There is also a lack of research-based evidence or clear consensus about the interpretation of an ABPI result. An ABPI of above 0.8 is advocated as indicative of an adequate arterial supply (Vowden and Vowden, 2001, Royal College of Nursing, 2006) although an ABPI above 1.2 may be a falsely elevated reading due to calcified arteries (Brooks et al., 2001). As discussed earlier (see p.25) universally accepted interpretations of the significance of ABPI data do not yet exist. The rigid application of these values as clear dividing values that lead to a patient with an ABPI of 0.79 receiving a very different diagnosis and treatment to a patient with an ABPI of 0.8 may be unhelpful in clinical practice. It is also important to note that even though Doppler assessment of ABPI has been found to be a reliable diagnostic technique for detecting arterial impairment, absence of arterial impairment does not automatically imply a diagnosis of uncomplicated venous insufficiency, since an ulcer can be due to a variety of causes other than venous insufficiency.

There is some evidence about pain as a possible diagnostic cue for venous leg ulceration. The literature used to state that venous leg ulceration was generally pain free and thus pain was used to differentiate between arterial and venous ulceration (Walshe, 1995). Subsequent research revealed the fallacy of this belief and a synthesis of qualitative research found evidence that pain is a "central and recurring" symptom associated with venous leg ulceration (Briggs and Flemming, 2007). However, recent research in the form of a prospective interview-based survey of 77 patients with leg ulceration found no relationship between different types of ulcers and minimum,

maximum and present pain scores. There was a statistically significant difference between venous, arterial and mixed ulcers for average pain with arterial ulcers being associated with the highest average pain scores. The survey results are likely to be valid and reliable, since probability sampling was used to draw a sufficiently large sample from a representative population of 510 patients on district nursing caseloads. Also, the original diagnoses were independently confirmed by a nurse with advanced knowledge and skills in leg ulceration using an agreed set of clinical signs, Doppler assessment of ABPI and a valid and reliable pain data collection tool (the McGill pain score) (Melzack, 1975). However, as the difference detected was related to 'average pain' which is difficult to assess in a diagnostic situation and the difference was only one point on a 0-6 pain scale, this result is likely to be of minimal use when making diagnoses in the clinical setting.

Therefore, while it is evident that the diagnosis of leg ulceration is multi-faceted, there is no research-based definitive diagnostic set of criteria or a cheap and easily accessible test for positively diagnosing venous leg ulceration in a community setting. There is good evidence to support the use of Doppler as a valid and reliable diagnostic test for identifying arterial insufficiency in an ulcerated leg, but excluding significant arterial disease will not automatically lead to a diagnosis of venous leg ulceration, as there are other causes of leg ulceration. In addition, factors may complicate the diagnosis of venous leg ulceration such as auto-immune conditions such as pyoderma gangrenosum, calcification of the skin or infection and some of the diagnostic signs and symptoms of venous leg ulceration (such as pain or previous trauma) are not exclusive to venous leg ulceration. Furthermore, venous leg ulceration is a condition of old age and thus likely to be complicated by concurrent disease.

In conclusion, there is currently no research evidence to support the positive diagnosis of venous leg ulceration. There is good evidence to support the use of Doppler assessment of ABPI for diagnosing arterial insufficiency, but this only supports differentiation between whether or not leg ulceration is caused or complicated by arterial insufficiency. The diagnostic criteria for venous ulceration itself currently lack research-based evidence, which means that the diagnosis of venous leg ulceration without the benefit of Duplex imaging is highly uncertain.

Evidence for treatment

Systematic reviews based on randomised controlled trials offer the strongest methodology for evaluating the effectiveness of treatments (Roberts and DiCenso, 2008) by rigorously identifying and summarising the evidence from good quality primary studies to seek summary information that is more precise than that gained from a single study (Ciliska et al., 2008). Such information provides more robust foundations for such treatment decisions. Therefore, the literature was searched for systematic reviews of treatments for venous leg ulceration. Thirteen relevant systematic reviews were found. All the reviews used well-structured and comprehensive search strategies, had appropriate and pre-defined inclusion and exclusion criteria, adhered to high quality pre-determined quality criteria for including studies, and considered the level of heterogeneity in relation to decisions relating to conducting meta-analyses. Therefore, the results could be regarded as valid and reliable. All except one (Hardy et al., 2004) were up to date, in that they had been completed or updated within the last 4 years. The range of proposed interventions for promoting healing of venous leg ulceration includes core therapies which seek to improve venous blood flow (such as compression bandaging) and other therapeutic approaches to promoting ulcer healing.

Therapies which seek to promote venous blood flow

Compression therapy is the mainstay of treatment for venous leg ulceration. Compression therapy, in the form of tight bandaging or hosiery, applies greater pressure at the ankle than the calf, and aims to reverse venous hypertension, thus restoring metabolic balance within the skin. A Cochrane systematic review (O'Meara et al., 2009a) undertook a meta-analysis of 39 randomised controlled trials to establish whether the application of compression increased the chances of healing venous leg ulcers. There was clear evidence that compression more than doubles the number of people healed at one year compared to no compression (RR 2.30, 95% CI 1.29 to 4.10). The same review reported no difference in effectiveness between multi-component compression bandage systems containing an elastic bandage and single-component or multi-component systems that are composed of mainly inelastic constituents (such as short stretch bandaging) (RR 1.10, 95% CI 0.78 to 1.55).

The initial systematic review and a subsequent systematic review (which conducted a meta-analysis of patient level data from five eligible randomised controlled trials comparing four-layer bandaging (an elastic multi-component system) and short stretch bandaging) reported that ulcers healed more quickly with four-layer bandaging (RR 1.31, 95% CI 1.09 to 1.58). However, the difference in terms of median time to healing was only just over one additional week over a three month healing period (90 days for four layer bandage and 99 days for the short stretch bandage) which equates to only one or two extra nursing visits (O'Meara et al., 2009b). It is not known whether this would be regarded as an important difference to either the patient or the health care provider.

This evidence is supported by a recently published large randomised controlled trial which compared short stretch bandaging with four layer bandaging for healing venous leg ulceration in patients receiving community care. Both types of bandage were routinely used within the practice setting of the study. The trial reported no significant difference between the two groups in terms of time to healing, pain or health related quality of life. The authors concluded that it is likely that the active ingredient of treatment is compression and the skill of the bandager, rather than the type of bandage system. Any differences found in previous studies may be related to the nurses' previous familiarity (and thus higher level of competence and confidence) with the superior bandage system (Harrison et al., 2011) .

Therefore, there is good evidence that graduated multi-layer high compression is an effective treatment for venous leg ulceration, but at present, there is insufficient evidence to support an argument for one particular type of graduated multi-layer high compression over another. Since patient concordance is known to be a key factor in treating venous ulceration with compression (Adderley UJ 2007) and patient choice may be a factor in increasing patient concordance, it is reasonable to view the provision of any of the available graduated multi-layer high compression systems in the hands of a practitioner skilled in applying that particular form of compression as an appropriate evidence-based treatment decision.

Intermittent pneumatic pressure (IPC) is an automated mechanical method of delivering compression to swollen limbs. A Cochrane review found seven poor quality randomised controlled trials (Nelson E A et al. 2011). The review found evidence that IPC may increase healing compared to no compression but it was not clear whether

there is increased healing when it is used as an adjuvant therapy with compression. One of the studies included in the review (Coleridge-Smith et al. 1990) had found IPC to be considerably more effective than compression therapy alone but the healing rate in the compression arm was significantly lower than in similar compression studies. This raises the possibility that the results of this study might have been affected by a type 1 error ((that IPC might be more effective than compression therapy alone, when in reality it is not) possibly due to inadequate sample size. A search of the literature found no other relevant studies of adequate quality to inform the discussion. Intermittent pneumatic therapy may be useful when compression therapy is not an option, but there is insufficient evidence to support its use as a first line treatment.

Chronic venous incompetence has been linked with the development and recurrence of venous leg ulceration (Doughty et al., 2000). Reconstructive surgery of the deep venous system has been proposed as a method of correcting venous insufficiency and thus promoting healing of venous ulcers. A Cochrane review which sought to establish the effectiveness of such interventions found only one trial which had included patients with open venous leg ulceration, but as ulcer healing was not reported as an outcome in this trial so it was not possible to report on the effectiveness of this intervention (Hardy et al., 2004). A search of the literature found no more recent reviews or relevant trials.

The effectiveness of systemic medicines to promote venous blood flow has also been evaluated in Cochrane systematic reviews. Oral pentoxifylline is known to influence the blood flow of the micro-circulation and the oxygenation of ischaemic tissue and therefore may promote healing of venous leg ulcers (Jull et al., 2009). A review of evidence for the effectiveness of oral pentoxifylline for healing venous leg ulcers included 12 good quality randomised controlled trials. The review concluded that oral pentoxifylline promotes healing in venous leg ulceration as both an adjunct to compression bandaging (RR 1.56, 95% CI 1.14 to 2.13) and in the absence of compression bandaging (RR 2.25, 95% CI 1.49 to 3.39). More adverse effects occurred in people receiving oral pentoxifylline and compression than in those receiving compression alone (Jull et al., 2009). The most common adverse events were gastrointestinal disturbances such as nausea, indigestion and diarrhoea, which the participants were mostly able to tolerate. The economic analysis suggests that prescribing oral pentoxifylline may be cost effective but further research is required. So

oral pentoxifylline may be a useful adjunct to compression, particularly for those patients who fail to respond to compression alone or for whom delayed healing is anticipated. It may also have therapeutic value for patients who refuse compression. However, given that patients with leg ulcers are more likely to be elderly and at greater risk of the side effects of poly-pharmacy, adverse events are common (albeit usually tolerable), and as the cost effectiveness of treatment is currently uncertain, it is questionable whether oral pentoxifylline should be regarded as a standard initial treatment for all patients with uncomplicated venous leg ulceration.

Other approaches which seek to promote ulcer healing

A range of other therapies have been considered for promoting ulcer healing which include therapies applied to the surface of the wound and therapies which aim to promote healing through optimising cellular activity. Dressings are an obvious possible therapeutic approach, since it is customary to apply a dressing to a wound to absorb excess exudate, to protect the wound bed from physical damage and infection and for cosmetic reasons (Bale, 1997). Although compression bandaging systems cover the wound, allow high humidity at the wound bed while removing exudate and are thermally insulating, a low-adherent wound contact layer is still required to minimise the risk of the bandage sticking to the wound. Dressings impregnated with therapeutic agents may have the potential to actively promote healing.

The comparative effectiveness of dressings and topical agents for healing venous leg ulcers has been evaluated in three Cochrane systematic reviews. One review considered whether dressings were effective for healing venous leg ulcers. 42 randomised controlled trials were included, which compared a variety of dressings including hydrocolloids, alginates, hydrogels and other miscellaneous dressings. Hydrocolloid dressings were reported to be no more effective than simple low adherent dressings when used beneath compression (RR 1.09, 95% CI 0.89 to 1.34) but there was insufficient evidence to compare other dressing types (Palfreyman et al., 2010). So there is no research evidence to support the use of one particular type of dressing over another for promoting healing.

It has been suggested that bacterial infection can delay ulcer healing and therefore anti-microbial therapies may increase the chances of healing through reducing the bacterial load in a wound (O'Meara et al., 2010). Anti-microbial therapies can be delivered topically and the second review considered antibiotics and antiseptics for healing venous leg ulcers (O'Meara et al., 2010). 25 randomised controlled trials were identified which included 32 comparisons including systemic antibiotics and topical preparations. The trials of systemic antibiotics were too small to reliably detect any difference in effectiveness. The trials of topical preparations included one study which reported the use of cadexomer iodine to be effective in promoting healing (RR 2.29, 95% CI 1.10 to 4.74). However, the cadexomer iodine intervention required daily dressing changes and thus has limited generalisability to current UK community nursing practice where current recommended practice is weekly dressing changes (Royal College of Nursing, 2006).

Honey has also been proposed as a possible anti-microbial agent and the third review considered honey applied as a topical agent for promoting healing in wounds (which included trials of patients with venous leg ulceration) (Jull et al., 2008). Two trials which compared the effect of honey as an adjunct to compression for healing venous leg ulcers were included in the review. The two studies reported different effect estimates and it is possible that heterogeneity may account for the difference as the two trials did recruit slightly different populations and the trials had differing sample sizes. However, the I^2 statistic (which measures the level of homogeneity as a %) indicated a low level of heterogeneity (0%) which supported the appropriateness of pooling the studies. The meta-analysis of these studies reported no evidence that honey significantly increased healing at 12 weeks when used as an adjuvant to compression bandaging (RR 1.15, 95% CI 0.96 to 1.38),

At present, there is no evidence, only poor quality evidence or good evidence that finds no difference between different dressings, so no particular dressing type can be supported by research-based findings. This coupled with the concern about the increasing problem of bacterial resistance to antibiotics (O'Meara et al., 2010) and the increased risk of allergy in patients with venous leg ulceration (Cameron, 1998) would support the use of simple, low cost, low adherent dressings under compression bandaging (Palfreyman et al., 2010)

Skin grafting has been proposed as a method of stimulating healing of chronic wounds. Skin grafts can be taken from the patient's own skin (autografts), applied as a bioengineered sheet of skin which has been grown from donor cells (allografts) or be in the form of preserved skin from other species (xenografts). Artificial tissue engineered skin (bilayer artificial skin) which consists of a matrix which has been 'seeded' with cells relevant for skin repair has also been proposed as possible sources for skin grafts. A Cochrane systematic review found 17 trials which assessed the effectiveness of skin grafts for promoting healing in venous leg ulcers (Jones and Nelson, 2007). The trials were mainly small and of poor methodological quality but there was evidence to suggest that bilayer artificial skin used with compression was more effective than compression alone for promoting healing in venous leg ulcers (RR 1.51, 95% CI 1.22 to 1.88). However, lack of an intention to treat analysis in the analysed studies increases the level of uncertainty about this result. The review was reviewed and assessed as up to date in 2009. Bilayer artificial skin may be of benefit as an adjuvant therapy to compression, but at present there is no robust evidence to suggest that it should be used as a first line therapy for healing venous leg ulcers.

A range of other therapies have been considered for healing venous leg ulcers. Zinc is an essential trace metal that is needed for the function of some enzymes and hormones and it has anti-inflammatory effects on phagocytic cells. Zinc is known to impact on wound healing as zinc-deficient people heal more slowly (Wilkinson, 2012). A review considered the effectiveness of oral zinc for healing venous leg ulcers (Wilkinson, 2012). Six small studies were included in the review but all were of mediocre quality and a meta-analysis of four of these studies found no evidence to support the use of oral zinc (RR 1.22, 95% CI 0.88 to 1.68). Other medicines which have been proposed as possibly beneficial interventions include oral aspirin (Magolbo et al., 2011) and flavonoids (Scallon and Bell-Syer, 2007) but at present there is insufficient robust evidence to guide practice and a search of the literature found no other relevant studies of adequate rigor to inform the discussion. Therefore, there is no robust evidence to support the use of these therapies for promoting healing of venous leg ulcers.

Low energy laser therapy which is thought to enhance cellular repair has been evaluated in trials. A Cochrane systematic review identified four trials of adequate quality to be included in the review (Flemming and Cullum, 1999) but no evidence of benefit was

found and an update of the review in 2010 found no further relevant studies to inform this subject. Therapeutic ultrasound has also been viewed as a potentially useful intervention for healing venous leg ulcers. Higher intensity therapeutic ultrasound raises the tissue temperature which is thought to increase blood flow which may promote tissue repair. The non-thermal effects are thought to be related to the effect of sound waves within the tissue fluid. A Cochrane systematic review of therapeutic ultrasound which included eight small, poor quality, heterogeneous studies found no evidence of effectiveness in ulcer healing for this intervention (Cullum et al., 2010). However, the low quality of the evidence meant that the possibility of benefit could not be ruled out. A subsequent pragmatic randomised controlled trial, which compared low dose ultrasound delivered in conjunction with standard care to standard care alone in patients with hard to heal venous ulcers, found no difference with regard to healing rates. This was a large, high quality trial with adequate randomisation, full allocation concealment, blinded outcome assessment and intention to treat analysis and thus the results can be regarded as valid and reliable (Watson et al., 2011).

It has been suggested that electromagnetic therapy, thought to promote healing through the generation of an electromagnetic field, may be of therapeutic benefit. However, a Cochrane systematic review which found only three small trials of variable quality concluded that there was no evidence of therapeutic benefit in terms of healing venous leg ulcers (Aziz et al., 2011).

In conclusion, the research evidence to inform treatment clearly indicates multi-layer high compression should be the mainstay for promoting healing for venous leg ulceration. At present, there is insufficient evidence to suggest that any particular form of multi-layer high compression system should be regarded as more effective than any other. There is also good evidence to support the use of pentoxifylline as an adjuvant therapy to compression or, if compression is refused, as an initial therapy for promoting healing. There is currently no robust evidence to support any other therapies for healing, although further evidence of effectiveness may emerge.

Therefore, an evidence-based approach to promoting healing of venous leg ulceration might take a tiered approach. All patients with adequate arterial supply to the lower leg should be offered multi-layer high compression. In the absence of evidence to guide dressing selection, simple, low cost, low adherent dressings are a reasonable first line

choice. For patients who fail to respond to this treatment (or refuse this treatment) other treatments, particularly oral pentoxifylline and possibly cadexomer iodine, intermittent pneumatic pressure and bilayer artificial skin grafts may offer useful adjuvant therapies or alternative therapies (when compression is not option). However, such therapies may have implications in terms of uncertain efficacy, additional costs and potential side-effects.

2.3.3. The quality of UK care

The uncertainty around diagnosing and managing venous leg ulceration raises questions about quality of clinical care. As discussed in Chapter 1, the management of venous leg ulceration is primarily a nursing responsibility and, in particular, a community nursing responsibility since most patients are cared for in the community by community nurses (Callam et al., 1985, Posnett and Franks, 2007). Therefore, questions about the quality of leg ulcer care will primarily relate to the quality of community nurses' clinical judgements and decisions.

Assessing the quality of a judgement or decision is complicated. Quality of care is generally assessed by auditing practice against reputable clinical guidelines (National Institute for Clinical Excellence, 2002) and venous leg ulcer guidelines focus on healing as the primary outcome (SIGN, 1998, CREST, 1998, Royal College of Nursing, 2006). However, the treatment that increases the chances of healing can be uncomfortable and some patients may prefer increased comfort to healing (Briggs and Flemming, 2007, Brown, 2010). Qualitative research that explores the experience of living with a leg ulcer suggests that although other outcomes such as pain management and odour management are important to patients, healing remains a highly desirable outcome (Briggs and Flemming, 2007). Therefore, it is reasonable to assume that the majority of patients would define 'optimal' care as that which includes care that aims for healing. Assessing overall quality of care for venous leg ulceration by measuring practice against research-based guidelines that seek to promote healing is thus an acceptable approach.

However, assessing quality on an individual patient level is more complicated. Quality can be assessed in terms of rationality or accuracy. The audit approach described above, measures clinical care in terms of rationality, where care is assessed against adherence

to research-based guidelines. If however, the patient has already expressed their refusal to wear compression bandaging, then this would not constitute a good outcome, even though it followed a rational decision making process. Rationality can be a useful way of monitoring the quality of the decision making process, but must also allow consideration of the patient's views and wishes, since the definition of optimal care should incorporate the subjective views of all those involved in care (such as the patient as well as clinicians and the health care provider) (Dowding et al., 2012).

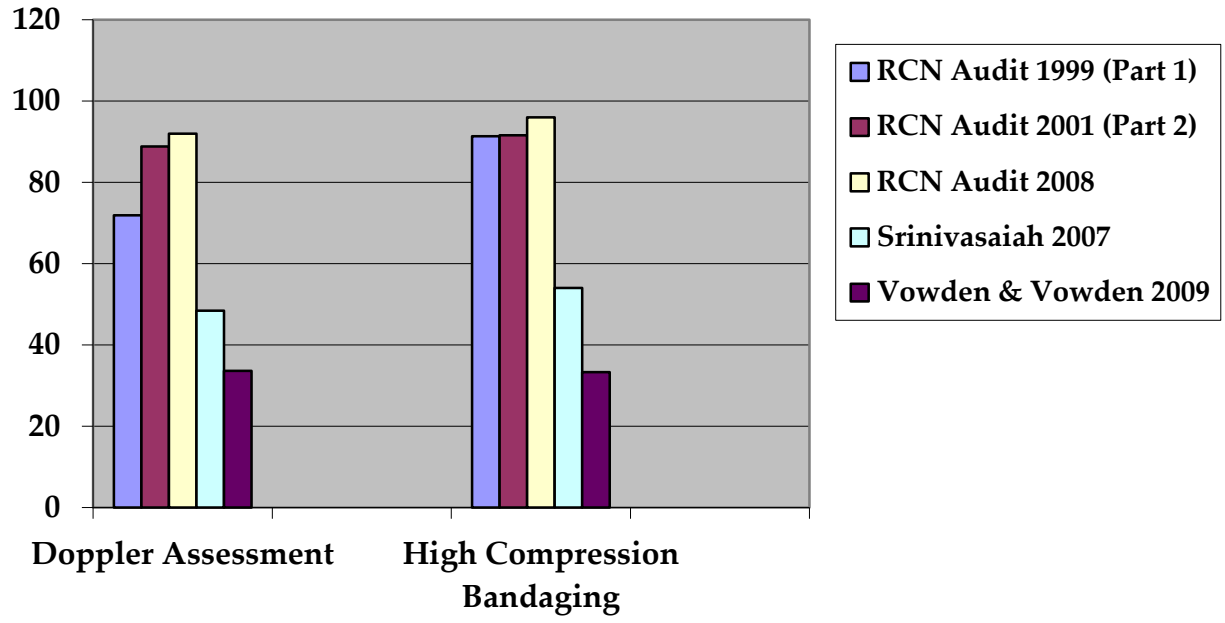
100% compliance with research-based recommendations is unlikely, since good evidence-based care should incorporate consideration of resources, clinical expertise and patient preferences, alongside research-based recommendations (DiCenso and Cullum, 1998). Doppler assessment of ABPI can be very uncomfortable and it is not always possible to accurately detect foot pulses. High compression bandaging can be uncomfortable and bulky so can affect mobility and impose limitations on footwear. Some patients will refuse these investigations and treatments, despite the evidence for their effectiveness. Therefore, when assessing the quality of care, it is necessary to establish to what extent actual practice might be reasonably expected to concord with such recommendations. The results of audits of leg ulcer care can be useful for indicating the minimum optimal level of the quality of care that is achievable in clinical practice and thus providing reliable comparators.

Audits of venous leg ulcer care have focussed on the quality of diagnosis (in terms of the provision of Doppler assessment of ABPI) and the provision of compression bandaging. Audits of leg ulcer care carried out in the 1990's (Roe and Cullum, 1995) (Stevens et al., 1997) found "widespread variation in practice, and evidence of unnecessary suffering and costs due to inadequate management of venous leg ulcers in the community" (NHS Centre for Reviews and Dissemination, 1997). In 1990 the RCN undertook a large two-part audit of leg ulcer care (Royal College of Nursing, 2001) and then continued to collect data through an on-going audit of leg ulcer care in participating organisations (Royal College of Nursing, 2008). In these later RCN audits, considerably more patients received care that was in line with research findings. 88.8% of patients received care which included assessment of Doppler and this improved to 92% in a later audit while 91.3% of patients with uncomplicated venous disease received high compression bandaging and this improved to 96% in the later

audit. These impressive results might be related to the voluntary nature of these audits: the audits may have attracted organisations with an existing commitment to improving leg ulcer care that saw participation as a tool to deliver further improvements. However, these audits were undertaken in community nursing settings and thus indicate a level of practice that is achievable within actual practice.

Audit information only describes the situation in the organisations which participate and thus cannot be reliably generalised to other organisations. However, when audits from different organisations indicate differing levels of quality then it is reasonable to view this as evidence of variation in the quality of care. Two more recent large pragmatic audits of leg ulcer management found much lower levels of alignment with evidence based practice (Srinivasaiah et al., 2007, Vowden and Vowden, 2009) (Figure 2.4).

Figure 2.4 Graph showing proportion of patients with venous leg ulceration who received Doppler assessment of ABPI and/or compression bandaging



In the East Yorkshire audit only 51.5% of patients with leg ulceration had received an assessment that included Doppler assessment of arterial supply and only 54% of patients with uncomplicated venous disease were treated with high compression systems (Srinivasaiah et al., 2007). The Bradford audit found that 66.4% of patients with leg ulceration had received a Doppler assessment and only 33.3% of patients diagnosed

with uncomplicated venous leg ulceration received high multi layer compression (Vowden and Vowden, 2009).

The level of practice in East Yorkshire and Bradford audits cannot be interpreted as indicative of community nursing practice in general. However, since these audits were pragmatic in that they used whole population sampling and observation of actual clinical practice and documentation to inform their results, they are likely to be accurate records of actual practice within those geographical localities. The gap between the results of the RCN audits and those of the pragmatic audits suggests that suboptimal care for patients with venous leg ulceration may be more widespread than suggested by the RCN audit results alone. The possible reasons for the discrepancies between the audits are unknown but possibly due to clinical complexity and uncertainty associated with clinical judgement and decision making for leg ulceration.

2.3.4. Conclusion

This chapter has examined the concept of clinical uncertainty in general and argued that evidence based practice offers an approach to minimising the impact of uncertainty on clinical practice. The evidence base in relation to venous leg ulceration has been described and critiqued and it has been established that although there is robust evidence to support the use of Doppler assessment of ABPI to identify arterial insufficiency of the lower leg, there is no research to support the diagnostic criteria for venous leg ulceration. There is robust evidence to support some elements of managing venous leg ulceration, in particular regarding treatment with multi-layer high compression. However, it remains unclear which compression system is most effective, how frequently bandages should be changed, which dressings are most effective with which compression system, and which types of patients should be offered adjuvant therapies. Audit evidence exists to establish achievable levels of quality performance in the management of venous leg ulceration, but this is only in relation to the provision of Doppler assessment of ABPI and the provision of compression bandaging. Recent pragmatic audits suggest that the quality of care delivered in the UK may be considerably below that which can be achieved. Although it is unclear how widespread this issue may be, there is sufficient evidence to suggest that there are issues

and problems regarding clinical judgement and decision making for the management of venous leg ulceration.

Clinical judgement and decision making is a fundamental process that links evidence and practice. The judgement and decision-making process links raw data (such as the patient's symptoms and the evidence base) with judgments and decisions (such as an appropriate diagnosis and treatment) and is thus the cognitive process of evaluating uncertainty in order to decide on an appropriate action. As most patients with leg ulcers are managed by community nurses, exploring the judgement and decision making processes of these nurses in relation to the management of venous leg ulceration would allow the 'black box' of clinical judgement and decision making to be unpacked in order to gain greater knowledge and understanding about this area of clinical practice. The next chapter explores the evidence base for clinical judgement and decision making for nursing in general and with particular reference to community based nursing care of leg ulceration.

CHAPTER 3

JUDGEMENT AND DECISION MAKING

Before exploring how complexity and uncertainty are addressed in managing venous leg ulceration, it is necessary to consider what is known about clinical judgement and decision making in relation to nursing in general. What types of judgements and decisions are made by community nurses? What forms of cognition do nurses use to make judgements and decisions? What factors affect their judgements and decisions? This chapter considers the existing evidence base in order to establish a basis for further investigation into community nurses' judgement and decision making for venous leg ulceration.

3.1. Cognition, judgement and decision making

Defining decision making to include both judgement and decision making is useful when applied to the real world practice setting since 'decision making' in clinical practice usually includes both judgement ("the assessment of alternatives") and an accompanying clinical decision ("choosing between alternatives") (Dowie, 1993, p8, Thompson and Dowding, 2002). However, academic analysis involves close examination of a phenomenon in order to closely explore its component parts. Therefore, when studying clinical decision making, it is helpful to consider *judgement* and *decision making* individually since they refer to different psychological phenomena and vary in terms of function and process.

Judgement has been defined as "the assessment of alternatives" (Dowie, 1993, p8) or an 'opinion' (Weiss et al., 2006): in clinical terms, clinical judgement is a clinical opinion and can thus be associated with the process of clinical assessment and diagnosis. *Decision making* has been defined as "choosing between alternatives" (Dowie, 1993, p8) : in clinical terms this is associated with the delivery of care. The Oxford English Dictionary (2007) defines 'clinical' as "of or pertaining to the sick-bed" and 'decision' as "the action of deciding", "the final and definite result of examining a question" or "the making up of one's mind on any point or on a course of action; a resolution, determination" (OED, 2007) . Clinical judgement and decision making can

be defined as the action of judging and deciding on issues pertaining to the care of those with health needs. Within a nursing context, a clinical judgement usually demands an accompanying clinical decision thus closely interlinking both terms (Thompson and Dowding, 2002). Therefore, a broad definition of clinical decision making would be the assessment and subsequent choice between alternatives within a clinical setting. "Clinical decision making" is the most common term used to describe this process but alternative terms exist in the decision making literature such as "clinical inference", "clinical judgement", "clinical reasoning" and "diagnostic reasoning" (Thompson and Dowding, 2002). Clinical judgement and decision making in nursing thus separates judgements from decisions by portraying the assessment of (sometimes) complex, uncertain information to arrive at a judgement which leads to a decision choice.

The typology of nurses' judgment and decision making

Clinical judgements are clinical opinions and are associated with clinical assessment and diagnosis. Clinical decisions are choices about action and thus associated with delivery of clinical care. Research into the types of judgements and decisions made by nurses has shown a broad spectrum of judgement and decision making activity (Table 3.1 - Adapted from (Lamond et al., 1996a, Thompson et al., 2000a, Thompson et al., 2004).

Although all nurses are likely to make judgements and decisions that range across the whole typology, the heterogeneity in nursing roles and patient problems means that there will be variations regarding the frequency of certain types of judgements and decisions. The most common decisions required from nurses working in acute secondary care concern questions of treatment or intervention (Thompson et al., 2000a, McCaughan, 2002). The identification of additional types of decision required from community nurses (Thompson et al., 2004) suggests that decisions relating to prevention, referral, assessment, diagnosis and, more rarely, information seeking occur more frequently for primary care nurses than for acute nurses. This finding concurs with the fact noted in Chapter 2 that community nurses are predominantly responsible for the diagnosis and treatment of leg ulceration.

Table 3.1 Typology of nurses' judgement and decision making.	
Type	**Example of clinical questions/ choices**
Assessment: Judging alternative forms of clinical assessment.	Assessing whether a diagnostic test is required
Assessment: Deciding what mode of assessment to use	Choosing to do an ABPI
Diagnosis: Judging signs and symptoms as a basis for treatment	Assessing whether an ulcer is due to venous hypertension
Intervention / effectiveness: Judging the likelihood of effectiveness of a particular treatment	Assessing whether compression bandage is likely to be effective
Information seeking: Judging whether more information is needed before making a clinical decision.	Assessing what information is available
Information seeking: Deciding what form of further information is needed	Choosing to ask a colleague's advice
Intervention / effectiveness: Deciding what form of treatment will be offered.	Choosing compression bandaging rather than dressings alone
• **Targeting**: deciding which patient will benefit most from a treatment	Choosing which patient should get oral pentoxifylline
• **Prevention:** deciding which intervention is most likely to prevent recurrence	Choosing to review patients 6 monthly
• **Timing:** Deciding on the best time to deploy the intervention.	Choosing a time to start compression bandaging
• **Referral:** Deciding whether to refer to another clinician	Choosing that a patient's leg ulcer merits surgical intervention
Experiential understanding or hermeneutic: Judging how cues should be interpreted	Assessing the anxiety levels of a patient
Communication: Deciding how to deliver and receive information	Choosing how to approach a potentially difficult conversation
Service organisation/ delivery and management: Judging the options for the configuration of service delivery	Assessing the options for delivering care in the community
Service organisation/ delivery and management: Deciding how care will be delivered in the community.	Choosing to deliver leg ulcer care through a clinic rather than through practice nurse appointments.

As discussed in Chapter 2, Eddy identifies seven principal areas of uncertainty in physician practice; defining a disease, making a diagnosis, selecting a procedure, observing outcomes, assessing preferences, 'putting it all together' and consequences (Eddy, 1996). The typologies of nurses' judgement and decision making suggest that there are large areas of overlap between nurses' judgements and decisions and physicians' judgements and decisions since a large part of nurses' judgments and decisions are concerned with effectiveness, targeting and timing of interventions (Thompson et al., 2004). A substantial proportion of nurses' judgement and decision making occurs in relation to the management and treatment of patient problems rather than disease (Cioffi, 2002) but nursing's focus on managing 'problems' as opposed medicine's focus on managing 'disease' is not significant in judgement and decision science terms. Furthermore, the management of leg ulceration requires nurses to diagnose and make treatment judgements so the uncertainties associated with medical practice are also likely to exist in nursing management of leg ulceration.

3.2. Cognitive approaches in nursing judgements and decisions

3.2.1 Theories of judgement and decision making

Theories of judgement and decision making provide frameworks to describe and explain the processes involved in judgement and decision making and for testing hypotheses through research (Higgs and Titchen, 2000). The evolution of the theoretical background to clinical judgement and decision making has resulted in theories of judgement and decision making being categorised as *normative*, *descriptive* or *prescriptive* (Thompson and Dowding, 2002).

Normative theories seek to generate information about how optimal judgements and decisions should be made such as "How should a community nurse decide which treatment to offer a patient with a venous leg ulcer?" *Descriptive* theories seek to describe the actual process of judgement or decision making such as "How does a community nurse decide which treatment to offer a patient with a venous leg ulcer?" *Prescriptive* theories address "How could…." questions such as "How could a community nurse make a clinical diagnosis about the aetiology of a leg ulcer?"

Prescriptive theories attempt to close the gap between the real life process of decision making and ideal decision making and are used to underpin systems to support decision making such as clinical guidelines (Rycroft-Malone, 2002) and computerised decision support (Crouch, 2002).

Descriptive theories originate from psychology and seek to describe the actual process of how decision makers reach a judgement or make a decision (Cooksey, 1996f). Real life healthcare is plagued with uncertainty, since the clinical environment contains imperfect information and wide variability in terms of cause and effect. In addition, decision makers are prone to the errors and biases that can adversely affect the quality of any decision (Eddy, 1996). Descriptive theories aim to accurately capture the actual process of how individuals make decisions in imperfect real life situations (Thompson and Dowding, 2002).

Intuition and expertise

There is evidence to suggest that nurses employ a variety of cognitive processes when making judgements and decisions but Benner's Theory of Intuition and Expertise (Benner, 1984) has heavily influenced how the nursing profession has viewed judgement and decision making (Eraut et al., 1995, Lamond and Thompson, 2000).

Intuition has been defined as:

> "the unconscious, internalised cognitive process that results in the understanding that effortlessly occurs upon seeing similarities with previous experiences" (Dreyfus and Dreyfus, 1986, p28)

Benner's Theory of Intuition and Expertise is founded on the Dreyfus and Dreyfus model of skill acquisition which was originally developed to study airline pilots' performance in emergency situations (Dreyfus and Dreyfus, 1986). Dreyfus and Dreyfus propose that adult humans usually learn new skills through a staged process that passes from initial written or verbal instructions (*knowing that)* through at least five intermediate cognitive stages until arriving at a stage of intuitive proficiency (*knowing how).* Benner applied the Dreyfus' model of skill acquisition to nursing to examine the differences in decision making between novice and expert nurses and proposes that a

novice nurse requires rules to guide their action whereas an expert nurse appears to internalise decision-making at an almost unconscious level of cognition so that their practice appears *intuitive* and fluid. The term 'expertise' refers to the "characteristics, skills, and knowledge that distinguish experts from novices and less experienced people" (Ericsson, 2006, p12). In nursing, expertise has been defined as flexibility and speed in practice (Benner, 1984, Ericsson et al., 2007) but capturing the characteristics that mark a practitioner as 'competent' or 'expert' has proved challenging.

Expertise can be examined from two approaches. The relative approach studies expert practice in comparison to that of novices and assumes that novices can achieve an expert level of proficiency. In contrast, the absolute approach identifies expertise through some form of performance measure. This might be a retrospective measure (by examining the success of an outcome), a concurrent measure (such as how well an exceptional expert performs a task) or through the use of an independent index (such as the speed with which a task is successfully performed) (Chi 2006). Historically, it has been widely believed that expertise is associated with intelligence, experience, and organisation of knowledge and education but the complete list of components that contribute towards expertise is currently unknown (Ericsson, 2006).

Benner's Theory of Intuition and Expertise connects intuitive cognition with expertise and experience (Benner, 1984) but subsequent research does not support the existence of a firm link between these factors. A systematic review of the relationship between clinical experience and the quality of health care found no evidence to suggest that (for physicians) length of clinical experience is linked with increasing quality of care, but that performance may decrease in relation to increasing experience (Choudhry et al., 2005). This finding is replicated in other professional fields such as clinical psychology and computer programming (Ericsson, 2004) and suggests that expertise is not an inevitable result of experience.

Academic attainment has also been proposed as a determinant of expertise but the benefit of academic education in terms of developing expertise is unclear. Although there is evidence that higher educational attainment in nursing is associated with greater confidence in utilising research, it is unclear whether this translates into better patient outcomes (Thompson et al., 2000a). An American study that examined educational levels of hospital nurses and surgical patient mortality found that having a higher

proportion of nursing staff with higher educational attainment was associated with lower mortality (Aiken, 2003). However, data from large scale epidemiological studies cannot be simply extrapolated to the level of individual nurse performance: a highly educated nursing workforce may be associated with lower mortality, but it does not automatically follow that an individual nurse with high educational qualifications will deliver higher quality care than their less highly educated nursing colleagues. Although a correlation between expertise, academic achievement and experience seems plausible, it is unlikely to fully explain the development of expertise since some practitioners, despite extensive education and experience, may never attain expert level.

It has been suggested that expertise might be more closely linked with a range of uncertain internal factors such as an individual's mental capacities and personal talents (which may or may not be amenable to experience and education) (Ericsson et al., 2007). A review of research into learning and skill acquisition found that when practitioners focus on a well-defined task, receive detailed immediate feedback on their performance and are able to undertake the same or a similar task repeatedly (i.e. deliberate practice) they consistently and gradually improve to the level of stable competent performance. However, expert performance only emerges in those practitioners with innate personality attributes that drive them to constantly improve and develop their skills through constantly seeking challenges that exceed their current levels of competence (Ericsson, 2004). Defining the components of expert performance is challenging and may only be possible when expertise is studied in a controlled setting (Ericsson, 2006).

Absolute approaches to defining expertise may enable more rigorous study of expertise and can be found in expert performance approaches that focus on measuring and analysing "reproducibly superior performance on representative tasks within the domain" (Ericsson et al., 2007, p E59). A representative task that encapsulates the essence of expertise in a very specific area can be identified: an expert will be able to reproduce consistent superior performance on such a task in a variety of situations, including laboratory conditions. This would allow the examination of the components that contribute towards expert performance through the use of retrospective studies. Simulation of a patient assessment situation could be applied in a controlled environment to enable researchers to analyse the cognitive processes of a practitioner

whose consistently superior practice under standardised conditions identifies their 'expert' performance in this aspect of care (Ericsson et al., 2007). A possible example of such a representative task in the specific domain of nursing patients with leg ulcers might be the swift and accurate diagnosis of the aetiology of a leg ulcer. An expert-performance approach might also enable comparative studies of less expert practitioners to be undertaken.

If expert-performance theory is accepted as a more reliable approach to identifying expertise, then Benner's research, which relies on social criteria such as length of experience and peer nomination to identify expertise, must be viewed as less valid and reliable. Peer nomination may be based on the outcomes achieved by the 'expert' in their area of expertise and thus have some validity. However, the use of length of experience to indicate expertise raises concerns about internal validity since the existing evidence suggests no causal relationship between length of experience and expertise (Choudhry et al., 2005). It is possible that Benner's 'experts' may not have met valid and reliable definitions of expertise and thus Benner's Theory of Intuition and Expertise may be resting on uncertain foundations.

Another issue of concern is the definition of intuition as something "that cannot be verbalized, that is verbalized with difficulty or for which the source of knowledge cannot be determined" (Young, 1987, p53). If the intuitive theoretical assumption that each clinical decision making situation is unique (and thus almost completely context-specific) is accepted, then transfer of 'intuitive' knowledge between clinicians is theoretically impossible since the decision making process cannot be described, defended or shared. Such assumptions inhibit the development of nursing's knowledge base (Thompson and Dowding, 2002). However, despite these caveats, Benner's Theory of Intuition and Expertise does acknowledges the complexity of the decision making process even if it does not sufficiently capture the detail of that complexity (Thompson, 1999a).

There have been several studies that have explored the cognition of nurses in relation to judgement and decision making for wound care. One large qualitative study that explored British community nurses' decision making regarding wound care reported that decision making was found to be consistent with both the theories of intuition reasoning and diagnostic reasoning (Hallett et al., 2000) while a multi-national survey

of nurses' decision making approaches found that decision making was mainly intuitive (Lauri and Salantera, 2002). However, the rigour of these studies was weakened by poor internal validity, since the data consisted of participants describing self-selected events from the past: the passage of time may have affected the accuracy of the description in that what was described may not have been what actually happened. Furthermore, the wide variation both between the health care systems and cultures considered in the international study make it very difficult to draw meaningful conclusions that relate to British nurses' UK decision making. Another British qualitative study of twelve UK expert nurses from a variety of clinical settings, identified the role of intuition in clinical decision making but noted the problems of researching intuition due the Hawthorne effects associated with the conscious recollection of intuition (Orme and Maggs, 1993).

Studies that have analysed verbal reports of cognition have reported that what was previously thought to be intuitive cognition is actually a cognitive process that utilises elaborate encoding and indexing of information to anticipate and enable superior future retrieval of information from the memory (Ericsson et al., 2007). The process of verbalising intuitive cognition may alter the cognitive process from unconscious intuition to a conscious form of cognition. It is also possible that the process of remembering prompts the subject to seek a meaningful cognitive structure for that memory (Koriat et al., 2000): an intuitive clinical decision may be later reconstructed as an 'information processed' decision. Alternatively, it is possible that intuition is actually very fast and very efficient information processing. Consequently, it is difficult to ascertain the validity of data that suggests intuitive cognition has or has not occurred.

Information Processing theory

Information processing theory uses analogies from computing and information technology to describe the human mind as an information-processing system that consists of processes (such as cognition) and structures (such as long term and short term memory). Human cognition is seen as dependent on learning (for the acquisition of knowledge) and memory (for the storage of that knowledge). Sensory inputs are transformed into a form which can be stored in the memory from where it can be

retrieved. However, not all sensory inputs will be stored and even if a sensory input is stored it may not be retrievable or accessible from the memory. The capacity of memory is measured in terms of *bits* of information (such as the number of digits or letters) but short-term memory is thought to have limited capacity for storage usually only retaining around seven bits of information (Miller, 1956).

Information processing theory incorporates Newell and Simon's concept of *bounded rationality* which proposes that the human mind has a limited capacity for rational thought (Newell and Simon, 1972). In clinical reasoning, bounded rationality means that the complexity of the presenting problem, plus the relatively small capacity of memory plus time pressures, seriously limits the capacity for rational thought. A bounded rationality view of decision making for leg ulceration would accept that a clinician is unlikely to remember the complete current evidence base for all the presenting clinical problems and also probably lacks sufficient computational skills and time to manage the appropriate data even if they could recall it. Therefore information processing theory views human reasoning as the interface between the stimuli from sensory inputs and memory, where external sensory inputs are perceived, receive attention, and are processed within the constraints of bounded rationality to reach a decision that leads to a response.

The information-processing approach to reasoning, with its assumptions of the limitations of bounded human rationality, has been used as the basis for researching how clinicians reason when making judgements and decisions (Thompson and Dowding, 2009). Some studies of nurses' cognitive approaches to judgement and decision making have suggested that some aspects of observed and reported decision making are consistent with theories of clinical information processing (Luker and Kenrick, 1992, Bryans and McIntosh, 1996, Luker et al., 1998, Hallett et al., 2000, Offredy, 2002, Junnola et al., 2002, Kennedy, 2002). However, most of these studies also noted that while information processing theory explained some aspects of clinical judgement and decision making in their studies, other theoretical approaches were required to give a more complete picture.

Hypothetico-deductive reasoning

The initial research studies that used information processing as a theoretical framework examined medical judgement for diagnosis. They concluded that medical clinicians use a four staged hypothetico-deductive approach to process information to make diagnostic judgements (Elstein et al., 1978). Initially information is gathered, such as signs and symptoms, to generate provisional, potential hypotheses. Cues are then classified as to whether they support, refute or do not contribute towards the provisional hypotheses. Finally, the clinician selects the hypothesis that is supported by the strongest evidence. More elaborate sequences have been proposed (Carnevali et al., 1984) but since they are not underpinned by any research, they must be regarded as potentially unreliable hypotheses.

There is evidence to suggest that nurses use hypothetico-deductive cognitive approaches. A British study which examined the judgement and decision making of eleven medical general practitioners and eleven nurse practitioners, found hypothesis evaluation to be the key component in their decision making (Offredy, 2002). Judgement about diagnosis and decision making about treatment appeared to follow information processing theory with pattern recognition against 'schema' held in the memory. The nurse participants were nurse practitioners who had undertaken a nurse practitioner degree programme and were working closely with a GP colleague and thus educated to deliver clinical care in a manner similar to the 'medical' model which has been linked with hypothetic-deductive cognition (Elstein et al., 1978). If these nurses were making judgement and decisions in accordance with a 'medical' model then it is questionable whether the results should be extrapolated to the wider nursing population. Having said this, as nursing takes on clinical care that was previously the responsibility of the medical profession, the dividing line between 'medical' care and 'nursing' care becomes more blurred so such distinctions are becoming less relevant. The use of information processing theory to underpin this study may have guided participants towards information processing cognition but it is unlikely that these participants would have used hypothetic-deductive reasoning if it was a completely unsuitable cognitive approach to the judgement tasks.

Heuristics and Biases theory

Heuristics and Biases theory also arose out of the recognition that the rationalist approach of normative theories did not appear to offer a descriptive fit with 'real life' decision making strategy, but rather cognition is influenced by the 'bounded rationality' circumstances of 'real life' decision making (Simon, 1955). Heuristics are cognitive short-cuts that use a "pre-existing mental map" to assist decision making as opposed to the more mentally laborious route of assessing probabilities and assigning utilities (utility theory), Bayesian synthesis and probability revision (Bayes theorem) or traditional symptom by symptom clinical analysis (Brannon and Carson, 2003b). However, heuristic approaches are flawed by their accompanying *biases* which are the unwelcome by-products which can lead to critical and systematic errors (Tversky and Kahneman, 1974). Bias is the "tendency to slant in one way rather than another" but the term can be conceptualised as a "systematic deviation from the norm" or "errors" or "fallacies" (Keren and Teigen, 2007). For example, representativeness heuristics may be used to reach a diagnosis but are prone to certain biases. So, for instance, venous leg ulceration has a close visual resemblance to pyoderma gangrenosum but is much more prevalent. Since decision makers appear to register descriptive information more easily than the statistical probability of a certain diagnosis (*insensitivity to prior probability of outcomes)* a clinician who is aware of pyoderma gangrenosum as a possible diagnosis and whose diagnosis is founded on judgement of similarity, is likely to over-diagnose pyoderma gangrenosum (Tversky and Kahneman, 1974). .

Subsequent research has identified several conceptual extensions to Tversky and Kahneman's original work, such as confidence heuristics which may result in decision makers showing a degree of confidence that is unmerited by the evidence upon which they base their judgments (neatly summed up by Samuel Johnson's description of second marriages as the "triumph of hope over experience" (Boswell, 1979). There is evidence to suggest that both overconfidence (Baumann et al., 1991) and under-confidence (Brannon and Carson, 2003a) feature in clinicians' decision making. Both may carry high costs for patients in terms of over/misdiagnosis or over/mistreatment and for health care providers in terms of spending on ineffective clinical interventions.

Fast and Frugal theory

Fast and Frugal theory challenges the assumption of heuristics and biases theory that the use of heuristics sometimes leads to faster but sub-optimal and unreliable judgements and decisions (Kahneman et al., 1982). Fast and Frugal theory proposes *satisficing* (Simon, 1983) in place of *optimizing* as an acceptable outcome aim. *Satisficing* (which merges *sufficing* and s*atisfying)* occurs when a heuristic achieves a successful outcome despite limited time, knowledge and cognitive ability (Gigerenzer and Goldstein, 1996).

Fast and Frugal theory returns to Simon's model of *bounded rationality* which addresses both the cognitive and ecological elements of bounded rationality. Gigerenzer and Goldstein argue that human cognition should be understood in relation to the ecology in which it takes place (Gigerenzer and Goldstein, 1996). Consequently the merits of heuristics cannot be judged outside the environment in which they are intended to function. For example, a heuristic that accurately identifies acute infection (pain, erythema, oedema, heat and purulence) may be misleading for assessing chronic wound infection (Gardner et al., 2001).

Gigerenzer and Goldstein developed an initial satisficing algorithm (*Take the Best)* which was based on the principle of 'take the best, ignore the rest' (Gigerenzer and Goldstein, 1996). This means that information cues are ranked according to their ability to distinguish between the two alternative options being considered. The cue that has the highest discriminatory ability is the 'best' cue: the rest are ignored. When tested against the speed and accuracy of a 'rational' algorithm (that incorporated all available information into a calculation) the 'Take the best' algorithm was found to be quicker and more accurate (Gigerenzer and Goldstein, 1996). For example, in leg ulceration the position, depth, colour and ABPI might all be cues that indicate arterial insufficiency. However, an ABPI below 0.6 might be the cue with the best ability to distinguish between a leg with sufficient and insufficient arterial supply. A 'Take the best' algorithm would simply use only the ABPI as an indicator of arterial insufficiency. Although other variations on the original 'Take the best' algorithm were developed and tested, none outperformed the 'Take the best' algorithm (Gigerenzer and Goldstein, 1996).

Dual Process theory

Dual Process theory proposes that analytical and intuitive approaches are cognitively related by analysis monitoring or correcting intuition in judgement and decision making (Paley et al., 2007). Although the concept of two different types of reasoning has existed for many years, the idea that the two different types of reasoning have different underlying cognitive processes is relatively recent.

Dual-Process theory (also known as Cognitive Experiential Self Theory (CEST)) proposes that humans process information using two parallel, interactive cognitive systems which have been labelled *System 1* (or *experiential)* cognition and *System 2* (or *rational)* cognition (Epstein et al., 1992, Stanovich and West, 2000, Evans, 2003). System 1 / experiential cognitive processes include the sub-systems that enable an animal or human to process information rapidly and automatically so that only the end result is noted in the consciousness. System 2/ rational cognition is thought to be uniquely human and involves slow, sequential, hypothetical thinking that may use reflection and the construction of mental models of future possibilities (Epstein et al., 1992).

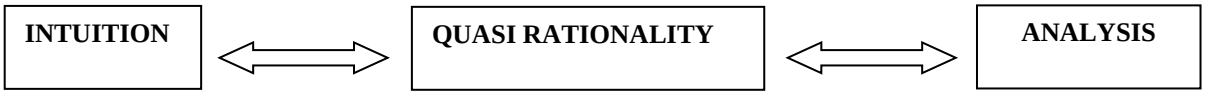
Experiential /System 1 cognition and rational /System 2 cognition may work seamlessly together or result in conflict when logical and belief-based cognition compete against the other. This may occur because people find it difficult to reason logically without being influenced by prior beliefs (Evans, 2003). For example, a nurse who believes that a certain dressing promotes healing, may be resistant to the results of a trial that suggests that the dressing is ineffective, especially if belief in the product is fostered by marketing claims that are not supported by research evidence (Dumville et al., 2012, Madden, 2012). It has been suggested that there is resistance within the nursing literature to the Dual System theory view of S2 cognition/knowledge playing a corrective/ monitoring role to S1 cognition/ knowledge since S1 intuitive cognition and S2 analytical cognition are often given equal status (Paley et al., 2007). For example, an expert's intuitive diagnosis of venous leg ulceration might be regarded as equally valid as a diagnosis arrived at by an analytical cognitive approach. Although the nursing literature uses terms such as 'integrating' 'balancing' and 'harmonising' as metaphors for the relationship between S1 and S2 cognition, there is no explicit description of how these are operationalised in practice (Paley et al., 2007).

It is not clear whether the role of analytical cognition as supervisory to intuitive judgements is accepted in nursing or whether intuitive judgements are still viewed as signs of clinical expertise (Benner, 1984) and thus superior to analytical cognition. It is possible that analytical cognition may play a significant corrective role in nurse decision making but that this form of cognition is internalised rather than vocalised.

Cognitive Continuum theory

Cognitive Continuum theory offers an alternative theoretical approach to explain the relationship between the type of cognitive approach and the type of judgement or decision (Cooksey, 1996d). Cognitive Continuum theory explicitly links intuition and analysis by ranging different forms of judgement and decision making along a continuum which runs from pure intuition at one extreme to pure analysis at the opposite extreme of the continuum (Fig.3.1).

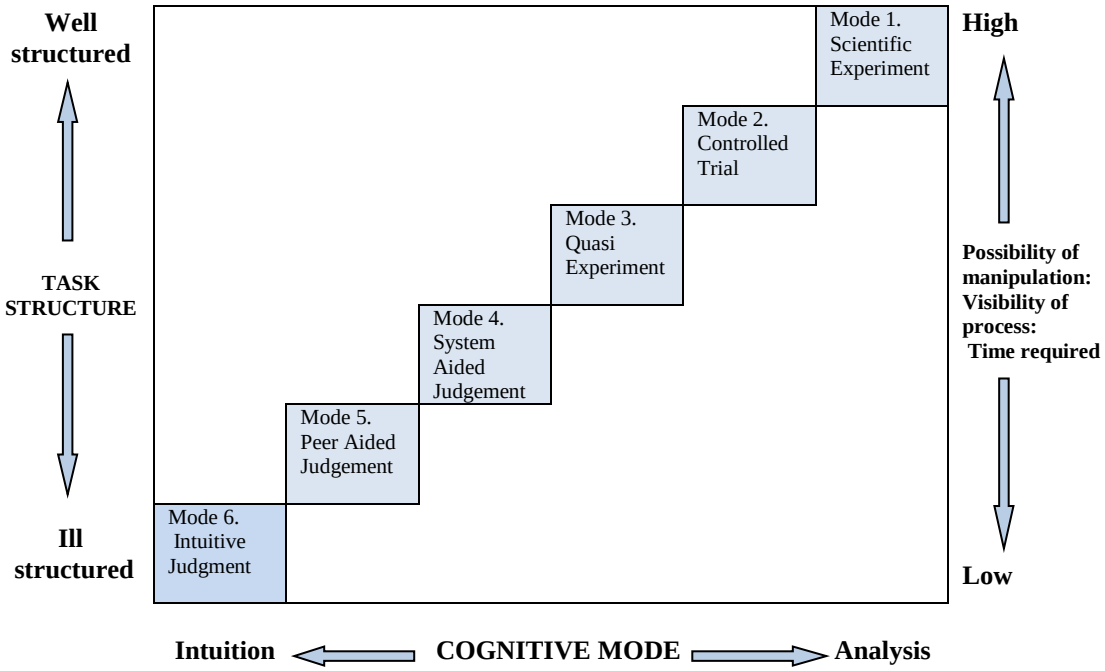
Figure 3.1 The Cognitive Continuum



As discussed above, intuition and analysis have been traditionally viewed as separate and opposing decision making approaches, although it has been postulated that intuition and analysis are not necessarily isolated from each other (Cooksey, 1996d, Paley et al., 2007). Cognitive Continuum theory acknowledges that judgement and decision making will contain elements of both intuition and analysis in varying proportions depending on where they occur on the continuum. Cognitive Continuum Theory also proposes that tasks can be ordered on a *task continuum* according to whether the decision task is more likely to induce a predominantly analytical approach or a more intuitive approach to decision-making (Cooksey, 1996d). Each mode is related to an accompanying

appropriate level of knowledge which supports the style of decision making at that level (see Fig. 3.2).

Figure 3.2 The Six Modes of Enquiry (Hamm, 1988)



For example, Mode 1 would use "highly analytical judgement" that is based on scientific experimentation that is fully controlled and usually occurs within a laboratory. Such forms of knowledge are rarely available to support judgement and decision making for venous leg ulceration, since highly controlled laboratory experimentation has little relevance to wound care in the clinical setting. However, decisions about treatment using knowledge gained from pragmatic randomised controlled human trials into compression bandaging does allow the possibility of Mode 2 "moderately strong analytical judgement". By contrast, judgement about diagnosis may be limited to Mode 5 "moderately strong quasi-rational judgement" since the lack of a robust evidence base means that knowledge is based on peer-aided judgement such as guidelines advice based on expert consensus. "Mode 6 judgement uses "weak quasi-rational intuitive judgement" when knowledge can only be based on 'professional opinion" such as when making a judgement based on patient preferences (Hamm, 1988).

Certain characteristics have been associated with intuitive and analytical thinking (see Fig. 3.3)

Figure 3.3
Hammond's Cognitive Continuum depicting the properties of intuitive and analytical thinking (Cooksey, 1996d)

CHARACTERISTICS	INTUITION ⟷	QUASI-RATIONALITY	⟷ ANALYSIS
	Rapid information processing	Blends aspects of both poles of the continuum. In daily life, people tend to operate in this region of the continuum. Quasi-rationality may be more or less analytical or intuitive depending upon the relative mix of analytical and intuitive characteristics demanded by the information environment.	Slow information processing
	Simultaneous cue use		Sequential cue use
	Judgement Process not retraceable		Judgement process retraceable
	Logical rules unavailable		Logical rules available and used
	High confidence in outcome		Low confidence in outcome
	Low confidence in process		High confidence in process
	Errors normally distributed		Errors few but large when they occur
	Inconsistent (low cognitive control)		Consistent (high cognitive control)
	Low cognitive effort required		High cognitive effort required
	Leads to interpersonal conflict		Leads to resolvable conflict
	Reliance on pictorial / nonverbal cues		Reliance on quantitative cues
	Raw cue data / events stored in memory		Complex organising principles stored in memory
	Emphasizes right brain hemisphere		Emphasises left brain hemisphere
	Resistant to new cues		Responsive to new cues
	Cues evaluated at perceptual level		Cues evaluated at measurement level
	Vicarious functioning (including shifting cue utilisation weights)		Vicarious functioning obviated by concrete organising principle
	Weighted average organising principle		Task specific organising principle

Judgement tasks can be ordered along a continuum according to the mode of judgement they are likely to induce (Cooksey, 1996f). Figure 3.4 outlines the task properties that are thought to induce more analytical or more intuitive cognition.

Figure. 3.4
Hammond's Cognitive Continuum depicting the task properties which tend to induce more intuitive and more analytical thinking (Cooksey, 1996d)

CHARACTERISTICS	INDUCING INTUITION	INDUCING QUASI-RATIONALITY	INDUCING ANALYSIS
	Complexity of Task Structure	A mixture of intuition-inducing elements and analysis inducing elements will be evident in tasks which induced quasi-rationality. Cognition will tip towards whichever type of elements are dominant	**Complexity of Task Structure**
	Judgement scale has many alternatives: many steps to solution		Judgement scale has few alternatives: few steps to solution
	Large (>5) number of cues displayed simultaneously		Small (2-4) number of cues displayed simultaneously
	High redundancy among cues		Low redundancy among cues
	Continuous, highly variable cue value distributions		Dichotomous cues, values discrete, distributions unknown
	Equal weighting of cues in ecology		Unequal weighting of cues in ecology
	Linear relations between cues and criterion		Non-linear relations between cues and criterion
	Ambiguity of Task Content		**Ambiguity of Task Content**
	Organising principle unavailable		Organising principle readily available
	Task outcome not available		Task outcome readily available
	Unfamiliar task content		Highly familiar task content
	No feedforward (training / information) minimal feedback		Feedforward (prior skill / information) cognitive feedback
	High accuracy unlikely		High accuracy likely
	Form of Task Presentation		**Form of Task Presentation**
	A posteriori task and cognitive decomposition		A priori task and cognitive decomposition
	Continuous cue data		Dichotomous or discrete cue data
	Pictorial cue definitions, perceptually measured by subject		Quantitative cue definitions, objectively measured by subject
	Only brief time available for judgement		Long time available for judgement

Intuitive and analytical cognition have traditionally been viewed as relatively stable cognitive styles (Cooksey, 1996d) but Cognitive Continuum theory proposes that an individual's cognitive style alters as time (counted in minutes rather than hours) passes during the problem solving process. If the initial mode of cognition (*mode of inquiry)* does not lead to an acceptable solution, then the individual will adapt and use a different mode of cognition. For example, if a nurse is working under pressure they may intuitively decide to apply a certain type of bandaging. If however, the nurse has more time to consider their decision they may take a more analytical approach to bandage selection and seek out research evidence to inform their decision. If the bandage chosen intuitively does not perform as expected, then the nurse may change to a more analytical form of cognition to reach a decision.

It has been proposed that cognitive continuum theory offers a useful approach for exploring and describing nurses' judgement and decision making (Thompson, 1999a, Harbison, 2001, Cader et al., 2005) and several recent studies have used cognitive continuum theory as a theoretical framework for research into nurses' decision making (Offredy et al., 2008, Dowding et al., 2009).

3.2.2. The cognitive approaches of nurses

The evidence discussed so far suggests that nurses' judgment and decision making can be described using a range of frameworks but a description of cognition that is scientifically robust and comprehensive is elusive. Intuition is thought to play a significant role but the definitions of expertise used in Benner's Theory of Intuition and Expertise raise doubts about the validity and reliability of this theory. This along with the difficulties of accurately describing 'intuitive' practice cast doubt as to whether this description is adequate. However, there is scanty evidence of nurses regularly employing more analytic approaches such as those described by information processing theory and hypothetico-deductive reasoning theory.

Two key studies have noted the impact of theories of intuition in how nurses' view their decision making and noted the apparent paucity of analytic thinking in nurses' decision making. A qualitative research study for the English National Board for Nursing, Midwifery and Health Visiting research report used case studies and in-depth interviews with experienced nurses who were recognised as delivering high quality care to elicit information about links between theoretical knowledge and clinical practice (Eraut et al., 1995). The results found little evidence of analytic thinking and deliberation in the majority of nurse decision making and the authors noted the "Pandora-like qualities" (p1) of the results which revealed areas of uncertainty and controversy. A later study used qualitative research approaches and quantitative Q methodology to explore the data from 120 nurses working in hospitals. Although this study focussed on how nurses used research rather than cognitive approaches, the results found a lack of willingness and opportunity to engage with research which might suggest that analytical approaches are less likely (Eraut et al., 1995, Thompson et al., 2000a).

The evidence suggests that intuitive cognition is the more commonly reported form of cognition but it appears likely that nurses use a range of cognitive approaches when making judgements and decisions. The management of leg ulceration has been within the responsibilities of community nurses for a significant period of time and is regarded as a 'nursing' issue. However, the responsibilities of diagnosis and prescribing treatment more closely resemble traditional medical responsibilities which have been closely linked with hypothetico-analytical cognition. Overall, at present it is not clear which cognitive approaches are used by nurses responsible for leg ulcer management for judgements and decisions in this clinical field. More knowledge about nurses' cognitive approaches would provide useful information for the design of educational strategies to promote better critical thinking and decision-making skills to underpin patient care.

3.3. The factors influencing nurses' judgements and decisions

Cognition is the process which links data (such as knowledge drawn from evidence) with judgments and decisions (such as a treatment plan). Chapter 2 evaluated the evidence base for venous leg ulceration but this is only one source of data that nurses will use in the judgement and decision making process. The literature suggests a wide range of potential factors that may influence nurses' judgement and decision making but the quality of research is of variable quality. Research that uses survey techniques may omit relevant inputs unless founded on robust qualitative research. By contrast, qualitative approaches increase the likelihood of identifying a more complete range of influential factors but increase the risk of more inputs being identified than would actually be used in real life judgement and decision making. Table 3.3 summarises the literature on factors influencing nurses' judgement and decision making which will be discussed in more detail in this chapter.

Table 3.2 Factors influencing nurses' judgement and decision making

	(Adderley UJ 2005)	(Ashton & Price 2006)	(Boxer and Maynard, 1999)	(Bryans and McIntosh, 1996)	(Hall et al., 2003a)	(Hall et al., 2003b)	(Hallett et al., 2000)	(Kennedy, 2002)	(Lauri and Salantera, 2002)	(Luker et al., 1998)	(Luker and Kenrick, 1992)	(Offredy, 2002)	(Thompson et al., 2000a)
Factors relating to nurse knowledge													
Research knowledge	■	■	■				■		■	■	■	■	
Experiential knowledge	■	■	■				■		■	■	■	■	
Product Info / Adverts	■		■			■	■			■	■		■
Patient Related Info					■								
General reference works						■							
Original Research		■											
Local Guidelines			■										
Colleagues	■					■	■						■
Factors relating to resources													
Staffing levels	■		■	■						■			
Cost of products to NHS		■	■		■								
Cost to patient					■								
Availability of products		■	■										
Time to make decision	■				■								
Time to deliver care	■				■								
Factors relating to social / demographic issues													
Social convenience	■												
Communication ability	■						■						
Lives alone	■							■					
Relationship with carers	■							■					
Disturbance to patient					■								
Concordance	■				■								
Age										■			
Gender										■			
Factors relating to clinical issues													
Diagnosis	Not explicitly mentioned but self-evidently essential												
Infection	■												
Comfort/ Pain	■												
Exudate levels	■												

Factors relating to knowledge

As discussed in Chapter 2, knowledge derived from robust research evidence allows better informed action and thus increases the likelihood of achieving the desired outcomes. However, a report commissioned by the NHS R & D Programme (Thompson et al., 2000a) found evidence to suggest that nurses are more likely to use information gathered from colleagues or the patient or which is based on their own personal experience than to seek original research-based information. This report used qualitative interviews, observation and statistical modelling to explore the data collected from 120 nurses working in UK secondary care. Greater utility was found in human sources of information (particularly Clinical Nurse Specialists) than in text based or electronic sources of research information. A mixed methods study that used semi-structured interviews to gather data about the prescribing habits of 22 nurses supported this finding, suggesting that it seemed possible that prescribing nurses preferred to obtain information from people than from printed material (Hall et al., 2003a).

Earlier studies had proposed that although original research appears to affect wound care practice, its impact on clinical judgement or decision making at grass roots level is mainly indirect through its inclusion in local policies and guidelines (Boxer and Maynard, 1999, Ashton and Price, 2006). However, these studies had used less robust research methods (such as survey techniques using self-administered questionnaires) and subsequent research that used more robust, mixed research methods, found considerable variability regarding the implementation of guidelines (Sheldon et al., 2004). It seems likely that although clinical guidelines are valued as a product of clinical expertise, the actual extent to which they impact on clinical practice is uncertain.

There is evidence to suggest that nurses attach higher value to experiential knowledge over research-based knowledge. A qualitative study that used observation and semi-structured interviews to explore the decision making of 47 community nurses found evidence that attitudes towards research ranged from being seen as irrelevant to having some positive value for clinical practice (Luker and Kenrick, 1992). However, the same study found that some nurses were unable to articulate precisely the individual sources of their knowledge. This finding was echoed in a small qualitative study of decision making in which none of the nine community nurse informants were able to cite a

specific piece of original research that informed their leg ulcer practice (Adderley and Thompson, 2007). This might be because research-based knowledge has become absorbed into experiential knowledge: a nurse may be aware that application of compression therapy will heal a venous leg ulcer, but be unable to cite the research from which this knowledge derives.

Other sources of information that impact on judgement and decision making include nursing journals and written product information and advertising. While some of this information will be based on good quality research, research shows that nurses' views of pharmaceutical company information range from being a biased product that is not particularly useful for clinical decision making (Thompson et al., 2000a, Hall et al., 2003b) to an easily accessible evidence-based factor that influences decision making about wound care (Adderley and Thompson, 2007). Since manufacturers' representatives cannot, by nature of their employment, be regarded as unbiased clinical experts this suggests that nurses' decision making may sometimes lack the evaluation skills necessary to discriminate between unbiased and biased sources of influence.

Factors relating to resources

There is evidence to suggest that judgement and decision making is affected by resource issues. Qualitative studies using semi-structured interviews have found that the time available to spend with patients is a factor that influences clinical judgement and decision making for both prescribing (Hall et al., 2003a) and the frequency of compression bandage application (Adderley, 2005). District nurses reported that insufficient time with patients meant that they were unable to issue a prescription (Hall et al., 2003a). Time shortages also influenced the judgement and decision making of district nurses delivering leg ulcer care: time-saving strategies (such as selecting clinical interventions that minimised the need for visits) were favoured as a means of addressing such shortages (Adderley, 2005). Time may influence clinical judgement and decision making in terms of both accuracy (Gonzalez, 2004) and confidence (Petrusic and Baranski, 2002). A recent study which examined judgement and decision making in the critical care setting, found that time constraints did not significantly impact on accuracy, but did affect how nurses reached those outcomes (judgement strategy)

(Yang, 2009). However, the issue of 'time to make a decision' in community leg ulcer care setting differs from the critical care setting. Leg ulceration is a long-term chronic condition where the speed of decision making is unlikely to have a significant impact on the speed of recovery so long as the response is not excessively delayed (days rather than weeks). Delays may be inevitable due to the time needed to write and dispense prescriptions to obtain the necessary materials (such as the dressing or bandage system) and for those materials to arrive with the patient but these delays are unlikely to have a significant impact on patient outcomes.

There is also evidence that the cost of products is an influential factor. Community nurses reported external pressures from health care provider organisations to prescribe lower cost items and also reported concern about the cost of prescriptions form patients on lower incomes who were not exempt from prescription charges (Luker et al., 1998, Hall et al., 2003a).

Factors related to social/ demographic issues

Patient concordance refers to the level of agreement between the patient and the clinician about the care the patient will receive. A satisfactory level of patient concordance is essential for delivering effective clinical care and factors related to social issues can impact on clinical judgement and decision making. The evidence from qualitative research found that consideration of patients' rights to negotiate care that is socially convenient, comfortable and satisfies safety issues (such as the patient's mobility, their ability to communicate, whether the patient lives alone and relationships with carers) influenced decision making regarding the frequency of re-bandaging for patient with venous leg ulcers (Adderley UJ & Thompson C 2007).

Factors relating to clinical issues

A clinical decision for treatment usually follows a clinical judgement for diagnosis (as discussed above) so it is likely that diagnosis will be a factor for clinical decisions regarding treatment, but there may be other clinical issues that may also be factors. One factor identified in a qualitative study into clinical decision making about frequency of

re-bandaging for venous leg ulceration was the presence of infection (Adderley, 2005). An ulcer diagnosed with infection required more frequent monitoring and possibly more frequent bandaging. Pain, which is often associated with infection, impacts on patient concordance with compression therapy. A longitudinal study that used prospective data collection to study 96 patients receiving leg ulcer care in the community linked pain with compression treatment: 44% of patients offered full compression bandaging were unable to comply due to pain (Briggs and Closs, 2006). The findings of this study are supported by the findings of a synthesis of qualitative research about living with leg ulceration (Briggs and Flemming, 2007) which confirmed that pain is a significant factor for patients in relation to leg ulceration. A randomised controlled trial which compared two different types of compression bandaging found that 30% of patients screened were unable to tolerate compression (Nelson et al., 2004). However, there is evidence to suggest that although compression bandaging can increase pain at the beginning of treatment it can be pain relieving as healing progresses (Briggs and Closs, 2006). In either situation it is likely that pain is a factor that nurses consider when deciding on treatment. Furthermore, since there is also evidence that some clinicians are 'forceful' when persuading patients to comply with treatment decisions, clinicians are likely to vary in how pain impacts on their decision making (Briggs and Flemming, 2007).

The level of exudate has been identified in qualitative studies as another factor that impacts on clinical decision making for venous leg ulcer management (Adderley, 2005, Briggs and Flemming, 2007). Excess exudate was again linked with infection as a symptom but also had links with patient comfort since uncontrolled exudate could result in unpleasant wet bandages and maceration. Therefore, it is likely that community nurses consider infection, pain and exudate levels when deciding how to manage venous leg ulceration.

In conclusion, there is weak evidence to suggest that certain clinical signs and symptoms and the patient's wishes and opinions are considered within nurses' clinical judgement and decision making. Resources issues are also likely to be a significant factor, particularly in terms of time. Time does not appear to have a significant impact on accuracy but it may affect the cognitive approach that is used to reach a judgement or decision. The evidence for factors related to knowledge suggests that nurses prefer to

gain knowledge from human sources of information or experience rather than from text or electronic based sources of research information. It is possible that human sources of knowledge may have derived their information from primary research information or that research-based knowledge has become absorbed into experiential knowledge and thus the identified source of knowledge may conceal the original source of information. If so, there may be parallels with the evidence for nurses' cognitive approaches where very swift, internalised information processing forms of cognition might be mislabelled as intuition. For both issues, there is considerable uncertainty about what information is used and how it is cognitively processed within nurses' clinical judgement and decision making.

3.4. The research questions

The typology for nurses' judgement and decision making indicates that community nurses make judgements for diagnosis and decisions for treatment. It is likely that nurses use a range of cognitive approaches, but intuition is the most commonly reported cognitive approach and there is little evidence to suggest that nurses make much use of more analytical approaches. A wide variety of factors that impact on nurses' clinical judgement and decision making has been identified, but it is not clear how these factors are used in the management of venous leg ulceration.

Clinical uncertainty is inherent in clinical practice, but an evidence-based approach to practice which uses robust research as the starting point in the clinical judgement and decision making process, offers the most appropriate way to reduce clinical uncertainty. The existence of reasonably good evidence in relation to compression therapy makes this possible for the management of venous leg ulceration, although the evidence base for diagnosis is much less robust. Although nurses are responsible for this area of judgement and clinical decision making, the evidence base regarding their cognitive approaches is uncertain, and it is not clear how the relevant factors are managed in the decision making process. This in itself is not necessarily worrying but does raise concerns when coupled with the audit evidence suggesting possible sub-optimal care. Unpacking how community nurses manage the complexity of leg ulcer management might enable the discovery of approaches to promote optimal care.

Therefore, this thesis seeks to answer the following research questions;

- When information cues for diagnosing leg ulceration are available, how do community nurses use these cues?
- How optimal are community nurses' judgements when diagnosing venous leg ulceration?
- When information cues for making treatment decisions for treating leg ulceration are available, how do community nurses use these cues?
- How optimal are community nurses' judgements when considering whether or not to offer high compression for venous leg ulceration?
- What is the impact of 'expertise' on the judgement and decision making of community nurses?
- What cognitive processes do community nurses use when making clinical judgements and decisions about venous leg ulceration?

CHAPTER 4

METHODOLOGY

4.1. Epistemology

The focus of this thesis is on exploring how community nurses manage the uncertainty of venous leg ulceration when making diagnosis and treatment judgements. Therefore, an inductive theoretical approach, capable of exploring the complexity of clinical uncertainty within clinicians and within the clinical environment, was required. This approach had to be capable of defining what *should* be considered within judgements and decisions for venous leg ulceration and what *is* considered within 'real life' judgements and decisions to enable comparisons to be made. The impact of expertise and the identification of the cognitive processes used by these nurses also required examination.

In terms of epistemology, this thesis developed from an interpretist position since it sought to understand clinical judgement and decision making from the perspective of the nurse. However, it is also positioned within the positivist natural science tradition, since it assumes that there are laws that can be deduced that would enable nurses to alter their behaviour to achieve more optimal diagnoses and treatments.

Chapter 3 considered the theoretical approaches that have been used for considering clinical judgement and decision making. The research questions of this thesis required a theoretical approach which was capable of not only describing judgement and decision making ("How does a community nurse decide which treatment to offer a patient with a venous leg ulcer?") but which was had potential prescriptive functionality ("How should a community nurse make a clinical diagnosis about the aetiology of a leg ulcer?"). The thesis also aimed to discover knowledge that might contribute to closing the gap between the real life process of decision making and ideal decision making. The only theoretical approach which bridges both is Social Judgement theory (which incorporates Probabilistic Functioning, Judgement Analysis and Cognitive Continuum theory).

Social Judgement theory also offered benefits through being a correspondence based theoretical approach which evaluates quality in terms of accuracy. As discussed in

Chapter 2, quality can be evaluated in terms of *rationality* or *accuracy*. *Coherence* based theories equate quality with rationality and describe, explain, or predict the competence of a judgement according to the consistency with what would have been achieved using a set of pre-established rules (Cooksey, 1996f). *Correspondence* based theories assess the quality (accuracy) of a judgement or decision in terms of how well a judgement or decision fits events in the environment which is being scrutinised, rather than whether it rationally follows an internally logical set of rules (Cooksey, 1996d). For example, a correspondence theoretical approach would assess the accuracy of a leg ulcer diagnosis by examining the correspondence between that judgement and an independent 'gold-standard' judgement.

However, accuracy may not always be the most essential criterion by which to assess the quality of a judgement or decision. In some situations, speed, or the ability to use limited information to arrive at a reasonable decision (Goldstein, 2007) may be more important than achieving a highly accurate judgement or decision. For example, in clinical emergencies, a judgement that is fast and 'good enough' might be 'better' than one that is more accurate but slower, but the management of leg ulceration is not a clinical emergency. Therefore, accuracy is an appropriate primary aim if it can be sufficiently well defined in a manner which includes appropriate parameters for uncertainty.

Correspondence based theories offer a means of evaluating real life practice judgements against externally verifiable judgements, in order to measure levels of accuracy. Clinical situations present a collection of multi-choice tasks that require decomposition and analysis to discover what constitutes an accurate judgement or decision. Accuracy may be related to the ability to prioritise certain information and disregard irrelevant information (Lamond and Farnell, 1998, Offredy, 2002, Cooksey, 1996d). In venous leg ulceration, the decision whether to apply multi-layer high compression may include judgement and decision tasks such as whether to carry out a Doppler assessment of ABPI, how to interpret the ABPI result, deciding how to present information to the patient, deciding when to suggest commencing therapy and so on. This situation is in line with the movement to understand and optimise judgement and decision making in naturally occurring situations. Since the aim was to assess the quality of real life

judgements and decisions, a correspondence based theoretical approach was more appropriate for this thesis.

However, Social Judgement Theory is a theoretical approach which focuses on judgements rather than decisions (for which there are a variety of different theoretical approaches). Chapters 1 and 3 noted that the term 'clinical judgement' often relates to diagnosis, while the term 'clinical decision' often relates to treatment decision making. However, it can be argued that decision making for treatment is also a form of judgement, since it involves making judgements about the appropriateness or not, of a particular treatment for a particular diagnosis. In this thesis, the 'treatment decision' is framed as a clinical judgement as to whether or not a patient with a diagnosis of uncomplicated venous leg ulceration should be offered high compression. Therefore, Social Judgement Theory is an appropriate theoretical approach for both the diagnostic judgements and the treatment choices which are explored in this thesis.

Social Judgement theory has been used by several researchers to study clinical reasoning (Cooksey, 1996d, Harries and Harries, 2001b, Thompson et al., 2008). Social Judgement theory developed from Probabilistic Functionalism, which in turn was a response to the domination of psychological research of the 'controlled experiment' methodology of natural science. Egon Brunswik proposed that the most important role for psychology was to understand the relationship between an organism and its environment (Brunswik, 1955). Social Judgement theory recognises that clinical judgement occurs in circumstances of uncertainty, which bear little resemblance to controlled experiments. In Brunswikian research, accuracy, rather than rationality, is the measure of success and quality (Goldstein, 2007). The Brunswikian theoretical approaches of Probabilistic Functionalism, Social Judgment theory and the Cognitive Continuum have been grouped together under the umbrella term of Judgment Analysis to describe the theories and methodologies that developed as an integrated approach to psychological theory and research.

4.2. Judgement Analysis and the Lens Model

The research methodology for Judgement Analysis is underpinned by four key Brunswikian concepts:

- Probabilistic Functionalism
- Vicarious Functioning
- Representative Design
- Idiographic statistics

4.2.1. Probabilistic Functionalism

Probabilistic Functionalism meta-theory proposes that the uncertainty within an organism's environment should receive the same level of emphasis as the organism itself. (Hammond et al., 1975, Cooksey, 1996d). Probabilism refers to the principle that the probabilistic nature of the world means that phenomena will not always behave in a predictable fashion. For example, an ABPI result of 0.78 may not always indicate insufficient arterial supply since the diagnostic cut-off point of 0.8 is arbitrary rather than evidence-based and various factors such as patient position and clinician error may affect the reliability of the result. Uncertainty is unavoidable since the available sensory information is almost always ambiguous and the perception of that information will vary from person to person (Cooksey, 1996d). Judgement Analysis takes into account that the accuracy of decision making is dependent not only on the decision maker's viewpoint but also the context of the predictability of the environment which may vary from one environment to another (Cooksey, 1996d). Consequently, in line with the issues discussed in Chapter 2, the study of clinical judgement and decision making in nursing should pay equal attention to the uncertainty within a situation as to the nurse making the judgement or decision (Cooksey, 1996d).

Vicarious functioning

Vicarious functioning refers to the recognition that in a judgement or decision making situation, it is possible that the cues that contribute to a decision (such as the signs and

symptoms) may be interrelated to an extent that some may be partially redundant since they replicate similar information (Cooksey, 1996d). For example, slow capillary refill and intermittent claudication (lower limb cramping on exercise) can both be signs of arterial insufficiency. In Brunswikian research, the success of the decision depends on the cue being used in the most valid and appropriate way but this may be possible using a collection of different cues, providing the cues themselves are inter-correlated (Cooksey, 1996d). So, since slow capillary refill and intermittent claudication both suggest arterial insufficiency, the decision maker might appropriately trade one cue against the other if the two cues can be regarded as partially intersubstitutable for each other. In research that focuses on clinical judgement and decision making, a theoretical approach that takes account of such possibilities is desirable.

Representative design

The concept of representative design refers to the Brunswikian innovation of developing a methodology directly from the theoretical idea of probabilistic functionalism so that equal attention is paid to obtaining representative samples of the environment in which the organism is operating as well as a representative sample of organisms (Cooksey, 1996f). Instead of conducting research which sought to identify and extract factors which can be then examined using factor analysis approaches, representative design allows judgment and decision making to be examined in its natural, complex and entangled environment. In order to research how nurses diagnose a leg ulcer, the nurses should be observed making diagnoses in a situation that resembles as closely as possible the natural environment (known as the ecology) in which nurses make such judgments.

Cooksey proposes that the overall context of judgement analysis can vary within two broad dimensions (Cooksey, 1996d):

- *Task familiarity* (how familiar the judge is with a judgement task)
- *Task congruence* (to what extent information in the judgement task is presented in the manner in which it is presented in the actual ecology.)

Research that can be conducted within a ‘Cell A’ context (highlighted within Fig. 4.1) offers the potential for highest level of representative design.

Figure 4.1 Cooksey's categorisation of Judgement Analysis Research contexts (Cooksey, 1996d)

TASK FAMILIARITY	TASK CONGRUENCE: Concrete	TASK CONGRUENCE: Abstract
Familiar	***Cell A*** ▪ ***Judge has made these sorts of judgements before in real life*** ▪ ***Task information is represented and / or obtained in original units of measurement***	**Cell B** ▪ Judge has made these sorts of judgements before in real life ▪ Task information is represented and / or obtained using abstract conceptual variables
Unfamiliar	**Cell C** ▪ Judge has seldom, if ever, made these sorts of judgements before in real life ▪ Task information is represented and / or obtained in original units of measurement	**Cell D** ▪ Judge has seldom, if ever, made these sorts of judgements before in real life ▪ Task information is represented and / or obtained using abstract conceptual variables

The information to populate the judgement scenarios should closely resemble patient assessment situations in that each scenario contains a cue set that includes all the essential information for making the required judgement (Cooksey, 1996d). *Objective analysis of the ecology* is the most objective method of identifying the cues that should be used in a cue set and can be achieved through conceptually analysing existing published literature regarding the subject matter (Cooksey, 1996d).

The range of ecological situations within a Judgement Analysis design should be selected using probabilistic sampling (or random sampling) in order to gather a representative range of ecological situations. The results from such analysis then have generalisability to a wider range of situations (Doherty and Twenty, 2004). The 'power' of the study (the ability of a test to detect an effect of a particular size) is based

on the number of ecological situations ('scenarios') within the design, rather than the number of subjects (Cooksey, 1996c).

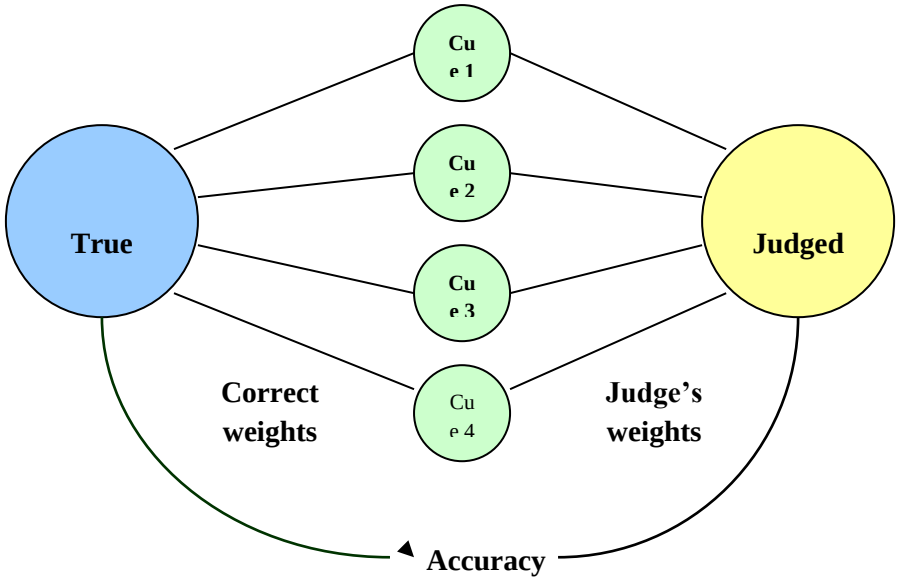
Representative design thus requires a variety of situations to be sampled from the ecology in which judgement and decision making takes place. In traditional, systematic research, experiments are conducted under identical and tightly controlled conditions. In research that uses representative design, data is gathered from a range of ecological situations which allows the relationships between judges and the variables within an ecology to be examined (Cooksey, 1996f). This then allows much more generalisable conclusions to be drawn which increase the relevance of such research.

Idiographic statistics

Data can be analysed at idiographic (individual participant) level or nomothetic (group) level and the relative merits of each approach in behavioural science research has been debated without resolution. Nomothetic approaches require the aggregation of idiographic data in order to apply statistical methods, such as the calculation of means or between-group tests, before the data has been understood at the idiographic level. However, Bunswikian approaches argue that data should be examined and understood at the idiographic level in order to understand the uniqueness of an individual's judgment making policy before nomothetic analysis is attempted. In Judgement Analysis, nomothetic analysis should only be undertaken if the idiographic data meets statistical tests of regularity or dependability (Cooksey, 1996f). This initial focus on idiographic level data encourages a more cautious approach to understanding possible patterns in the data.

Judgement Analysis methodology thus seeks to describe human judgement and decision making in naturalistic environments. However, it also seeks to establish the accuracy of this judgement and decision making. This is achieved through the adoption of Hammond's Lens Model. The Lens Model developed as a conceptual extension of probabilistic functionalism and perceives cognition as a form of lens (Fig 4.2).

Figure 4.2 The Lens Model (adapted from Cooksey 1996a)



The Lens Model' can be used as a theoretical model to study judgement. The left side represents the 'ecology' or true state (e.g. the actual diagnosis of type of leg ulcer). A variety of cues are linked to this side of the model (such as appearance of the wound, ABPI, pain etc.) and each cue has a 'weight' in terms of its relative importance. The right side represents the judge's judgement of the situation (such as the judge's diagnosis of type of leg ulcer). The accuracy of the judge's judgement is assessed by the level of correlation between their diagnosis and the true state. The judge will attach importance to cues when making a clinical decision which may or may not be similar to the cue's actual importance. The judge's judgement process can be unpacked by comparing how they have weighted the cues compared to the correct weight of each cue in the 'true state' (Hammond, 1966).

4.2.2. The Lens Model statistical equation

In Judgement Analysis, multiple regression is used to develop linear models which represent the relationship between the cues and the judgment, thus modelling the judgement processes of an individual judge (Cooksey, 1996a). Research has shown that the clinical predictions of clinical psychologists made using simple linear models are as

accurate or more accurate than those made using 'expert' clinical judgement (Meehl, 1954, Dawes, 1982). Further studies found that while clinicians usually select the important cues, linear models are better at combining the information from those cues. It has been suggested that, wherever possible, human judgement should be replaced by linear models (Grove and Meehl, 1996, Hastie and Dawes, 2001) but such an approach is usually incompatible with most real life clinical judgement and decision making which occurs in situations that are uncertain and time constrained. It is therefore, not surprising that real life clinical choices appear to be generally handled differently (Benner, 1984, Gigerenzer and Todd, 1999). Despite this, when used descriptively rather than prescriptively, linear (and logistic) regression modelling offers a useful approach for describing how judges value and organise information in the form of cues when making judgements.

Therefore, the linear models developed in Judgement Analysis studies offer a means of "capturing" aspects of the judgement process but are unable to accurately depict the whole judgement process (since they are mathematical models). However, evidence suggests that the aspects which such models can capture (such as cue weights, consistency and predictability) make significant contributions to understanding the accuracy and variability of people's judgements (Cooksey, 1996a).

The statistics for populating a Lens Model are derived from presenting participants with a number of scenarios based on the types of information and presentation of cases that would naturally occur in practice. The data from these judges informs the right hand side (the judged state) of a Lens Model. The left hand side (the ecology) is informed by data drawn from data drawn from a source which is viewed as optimal and reliable. This optimal ecological model can be used as a comparator against which the judgement policies of nurses (how nurse judges use information to arrive at their judgements or decisions and the accuracy of those judgements) can be evaluated.

In Judgement Analysis, the Lens Model Equation statistically represents the judge's achievement of accuracy. The original Lens Model Equation is:

$$\mathbf{R_a = GR_eR_s + C\sqrt{(1 - R_e^2)}\sqrt{1 - R_s^2}}$$

(Cooksey, 1996d)

Where:

- R_a: Achievement

  The achievement parameter refers to the correlation between the judge's judgment and the true state. Perfect correlation means that there is a perfect match. This value is interpreted as a measure of the judge's accuracy and indicates a judge's level of performance

- G: Linear knowledge

  The knowledge parameter represents the extent to which the nurse judge's use of the available cues within the judgement task corresponds to optimal cue use in the ecology. Using regression techniques, a linear model is developed for each judgement which gives each cue a relative weight that corresponds to its significance in that ecology. Similarly, a linear model is developed for each nurse judge's judgement which also gives each cue a relative weight that corresponds to its significance in that nurse's judgement policy. A correlation of the nurse's linear model and the ecological linear model can be viewed as the nurse judge's knowledge of the task ecology (Cooksey, 1996d).

- R_e: Predictability

  The predictability parameter represents the degree to which a linear model will vary in accuracy in predicting the ecological criterion (such as whether this actually is a venous leg ulcer) (Cooksey, 1996d). For example, since the ABPI measurement is not 100% accurate, no linear model that includes ABPI can be 100% accurate in terms of predicting whether a leg ulcer is complicated by significant arterial disease, or not.

- R_s: Cognitive control

  The cognitive control parameter represents the degree to which a nurse judge will vary in the weight (W_s) they attach to the individual cues within a judgement task (Cooksey, 1996d). For example, in one judgement profile the nurse judge may attach a very high weight (level of importance) to the ABPI cue but in another judgement profile attach very little weight to the same cue. Consequently, across the whole judgement task, there may be considerable variance in how the ABPI cue is weighted in that nurse's judgement process. Cognitive control is computed as a correlation between the actual judgements made by a judge and the judgements predicted by their judgement policy. *Consistency* is distinct from *cognitive control* in that it refers to similarity between judgements on the same judgement profile, rather than similarity across the judgement task (Cooksey, 1996d).

- C: Unmodelled knowledge

  The *unmodelled* parameter consists of those aspects of the ecology and judgement processes that cannot be captured in a linear model.

Therefore, the Lens Model Equation presents achievement in terms of accuracy (R_a) as a function of knowledge (G), predictability (R_e), cognitive control (R_s) and unmodelled knowledge (C).

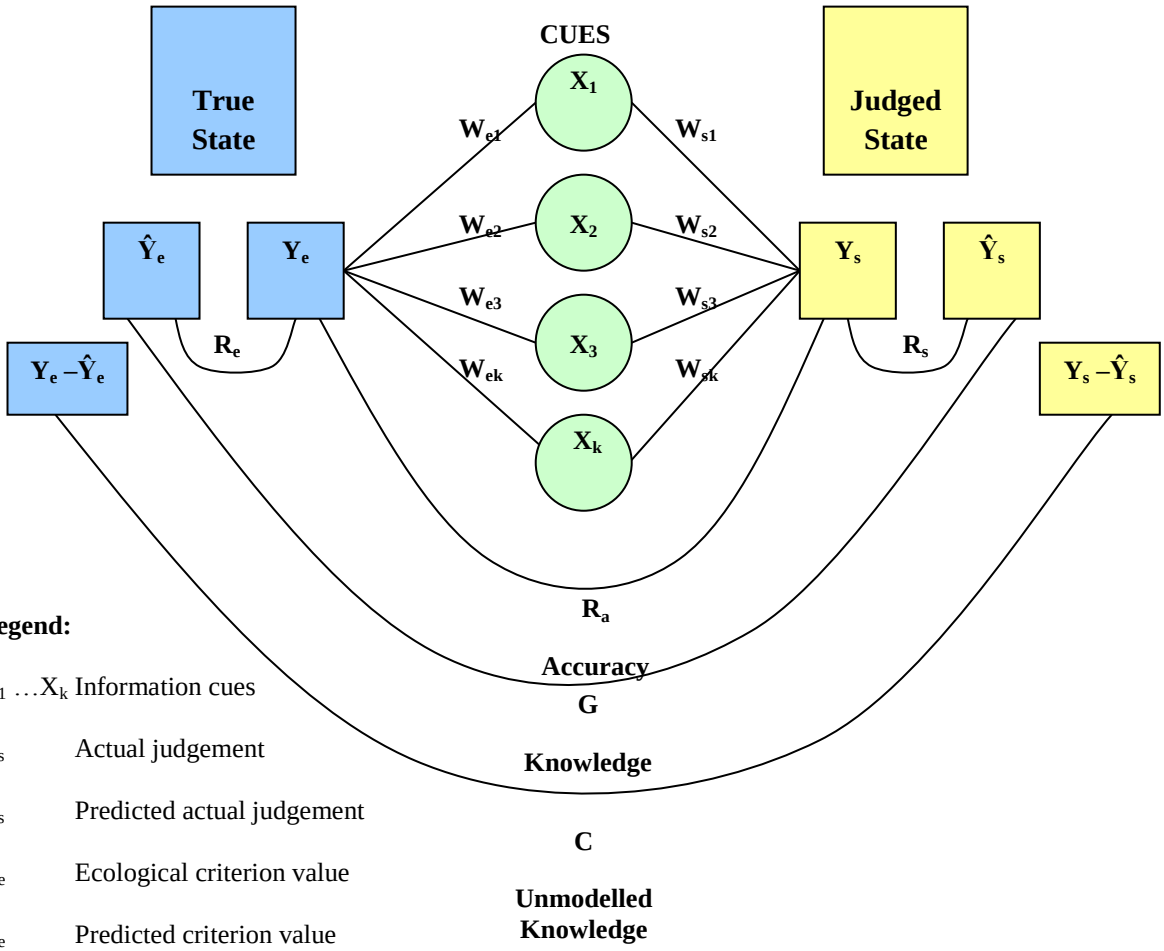
i.e. accuracy ($\mathbf{R_a}$) is a function of:

- the *linear* component $\mathbf{GR_eR_s}$ and
- the *unmodelled* component $\mathbf{C\sqrt{(1-R_e^2)}\sqrt{1-R_s^2}}$

Figure 4.3 illustrates how the Lens Model Equation relates to the Lens Model and it thus follows that by calculating these statistics, it becomes possible to answer research questions regarding accuracy, consistency and the use of factors (cues). The accuracy (R_a) of a judgement or decision can be evaluated by calculating the correlation between the ecological criterion (Y_e - the true state) and the nurse's judgement or decision (Y_s - the judged state). Consistency can be evaluated by calculating the variance in how the

cues are weighted in a nurse's judgement process (R_s) (and by comparing performance on replicated judgement scenarios). The use of factors (X_1 …. X_i) to arrive at a judgement can be calculated using regression analysis to express the relationship between the cues and the nurse's judgement ($W_{s1} - W_{sk}$).

Figure 4.3. Lens Model for comparing the judgement making policy of a nurse judge against an ecological criterion (Cooksey, 1996d)



Legend:

$X_1 \ldots X_k$	Information cues
Y_s	Actual judgement
$\hat{Y}_s$	Predicted actual judgement
Y_e	Ecological criterion value
$\hat{Y}_e$	Predicted criterion value
W_s	Judgement weights
R_a	Accuracy
R_s	Cognitive control
R_e	Predictability
G	Knowledge

4.2.3. Lens Model research designs

Social Judgement theory offers four alternative approaches to studying judgement:

1. Single system design
2. Double system design
3. Triple system design
4. N-system design.

In *single system* design the nurse is required to make judgements about a sample of cue profiles for which there is no objective information in relation to the true state (Cooksey, 1996d). The right side represents the clinician's judgement of the situation and the importance the nurse attributes to the cues when making this judgement but there is no true state against which to compare. A *double system* design compares the nurse's judgement against the known true state (as in Figures 4.2 and 4.3). A *triple system* design examines the judgements of two interdependent judges about the same situation in which the true state is known and thus enables the examination of the agreement and disagreement between two nurses as they interact with each other to arrive at a judgement (Cooksey, 1996d). Finally an *n-system* design enables the examination of judgement in a social context when there are many different judges and where the task ecology (the left hand side of the model) is often unknown.

This thesis sought to establish the accuracy of individual community nurses' judgements against known true states as well as how nurses make those judgements. A single system approach could have only established the intercorrelations between the cues and the distributional characteristics of each cue (e.g. means, range etc) rather than the accuracy of the judgement in relation to the true state. Since it was possible to obtain 'true state' data to furnish the left side of the model, this approach would have been unnecessarily restrictive. The triple system design is appropriate for examining judgements where more than one judge is involved in the same decision while the n-system design compares several different judgement systems. Nursing is a social activity where judgement may occur in consultation with other health professionals but the focus of this thesis was the accuracy of an individual nurse's judgements since each nurse is ultimately professionally responsible for their own performance. Therefore,

neither the triple system design nor the n-system design offered an appropriate design for this thesis. Instead, since data could be obtained to inform both the left and right sides of a Lens Model that would address judgement about diagnosis, and a second Lens Model which would address judgement about treatment, double system design offered the most appropriate research design approach. Double system design is capable of assessing judgemental accuracy as well as the relative relationships within both the environment and the judgement process.

4.3. Other methodological approaches

Although Judgement Analysis has descriptive and prescriptive functionality, it does not attempt to capture cognition during judgement and decision making. Judgment Analysis avoids the difficulties associated with relying on the participant's insight, ability to identify and verbalise unconscious thought and subjectivity as it requires the participant to simply make the judgement rather than attempt to access the processing of the judgement. However, this means that it is unable to address the research question of what cognitive processes are used by community nurses when making clinical judgements about venous leg ulceration.

Describing cognition in an accurate and robust manner is difficult. Different types of cognition might be defined by a description of the physiological cognitive process but, at present, the physiology of cognition within the brain cannot be directly observed. New technologies, such as magnetic resonance imaging (MRI) and electroencephalogram (EEG), are contributing towards the visualisation of brain activity but these technologies are in their relative infancy. The current absence of physiologically precise definitions of cognitive brain activity, means that cognitive processes can only be inferred from a person's actions or description of their actions, which may be flawed or incomplete (Gross, 2006).

Methodologies from other theoretical approaches have been employed to try to describe clinical judgement and decision making. Qualitative approaches based on ethnographic methodology have used data gathered through researchers' observations of an alien culture to examine clinical judgement and decision making but this approach has proved unreliable in accessing the holism of clinical reasoning. Routine thinking tasks can be

repetitive and therefore well-practiced, so cognition may become sub-conscious or intuitive and thus inaccessible to ethnographic methodology (Harries and Harries, 2001a). One ethnographic qualitative study provided its clinical participants with the field notes generated from field observation and asked them to define what they remembered as the key reflection points. These points were then used as the focus of in-depth interviews in which the participants were asked to reflect on the thinking that had taken place (Munroe, 1996). However, data obtained through this form of retrospection is not always valid since the memories of the participants may be flawed, there may be post-hoc rationalisation or the participants may simply not remember what they were thinking (van Someren et al., 1994).

Other techniques that aim to capture the cognitive process include 'introspection' and 'question and prompting' (van Someren et al., 1994). Introspective techniques ask the participants to report (and sometimes interpret) their thinking at intermediate stages during the problem solving task. Question and prompting techniques require the investigator to ask the participant questions or prompt them at given intervals to verbalise their cognitive processes. Both techniques interrupt the judgement process and oblige the subject to interpret their own thinking processes, so may be vulnerable to the same problems of flawed or incomplete memories or post-hoc rationalisation as retrospective techniques. Question and prompting techniques introduce the added complication of introducing other cues (the questions and prompts) during the decision making process (van Someren et al., 1994).

In theory, clinician reflection can be used to verbalise the reasoning process. but the accuracy and reliability of this data can be difficult to establish. Clinicians will not necessarily be aware of their intuitive cognition, they may have difficulty recalling some aspects of their reasoning and post-hoc rationalisation may occur (Harries and Harries, 2001a). Concurrent data collection when clinicians are asked to 'think aloud' during clinical judgement and decision making may offer a more valid methodology by using concurrent, rather than retrospective reflection.

4.4. Think Aloud techniques

Think Aloud techniques offer a process which turns obscured cognition into audible raw data that can be subjected to objective analysis (van Someren et al., 1994). The participant is presented with a simulated judgement scenario which contains a judgement or decision task. The participant is asked to verbalise their cognition while undertaking that task and audio-taping is used to capture this data. The audio-taping may also be supplemented by the researcher keeping field notes (Fonteyn et al., 1993). This data is then transcribed into 'protocols' which are then qualitatively analysed using a structured approach.

It is possible that Think Aloud techniques may overcome the challenges to validity of incompleteness due to memory errors and subjective interpretation but the resulting data may still not mirror actual cognition due to Hawthorne effects whereby people change their behaviour when being observed. Verbalisation may push cognition along the cognition continuum from unconscious intuition towards conscious information-processing (Hamm, 1988): it has been observed that even when participants are observed or interviewed close to the event, intuitive cognition is rarely reported (Ericsson et al., 2007).

The validity of Think Aloud verbal protocols has been questioned particularly in relation to the issue of reactivity. Research has suggested that the additional cognitive demand of informants being required to vocalise their thinking, may alter the cognitive approach. Vocalisation of thinking may improve recall and informants may thus learn new cognitive strategies during data collection. Furthermore, the increased self-awareness associated with being monitored in a study may motivate informants to take a different cognitive approach that may improve performance (Russo et al., 1989). It has also been noted that since the speed of thought exceeds the speed of speech, verbalisation may be an incomplete record of the cognitive process (van Someren et al., 1994). Verbalisation is a cognitive task in its own right which slows cognition and requires additional working memory capacity thus adding to the cognitive burden of a judgement task. Therefore it is has been suggested that Think Aloud techniques can only capture conscious clinical reasoning whereas many frequently performed thinking tasks, particularly the reasoning of experts in that judgement task, may become intuitive and unconscious (Abernathy and Hamm, 1994). Ericsson and Simon have challenged

criticism of the validity of Think Aloud protocol analysis as a means of describing cognition by arguing that Think Aloud techniques capture 'inner speech'(the spontaneous internal thoughts that are suppressed) rather than 'social speech' (the thoughts that are shared with others) (Ericsson and Simon, 1998). Social speech requires a different cognitive approach wherein informants reflect on their thoughts and monitor their speech to ensure it is comprehendible to the listener. By contrast, Think Aloud seeks the verbalisation of usually disconnected and incomplete inner speech (which is more relevant to judgement research) rather than explanatory, reflective social speech.

Think Aloud techniques has been found useful for data collection in terms of providing detailed data for informants' cognition, evidence that the Think Aloud data (*protocols*) are consistent with task analyses, and evidence that informants with same level of skill demonstrate similar forms of cognition (Ericsson and Simon, 1998). Think Aloud data is more likely to closely follow the order that events are presented to the decision maker and more likely to link judgements to subsequent decisions (Whyte et al., 2010). Therefore, although Think Aloud' techniques are not a perfect solution to the challenge of capturing cognition during judgement and decision-making, they do appear to offer the best current option.

4.5. Methodologies for this thesis

This thesis sought to explore nurses' accuracy and optimal use of information when diagnosing venous leg ulcers and treatment choices. It also sought to explore the impact of expertise and to identify what cognitive processes were used. Social Judgement theory has been used as a methodological approach in other studies examining nurses' judgements (Thompson et al., 2008, Yang and Thompson, 2010). Within community nursing, it has been suggested that Social Judgement theory might offer a useful theoretical explanation for how judgement occurs (Kennedy, 2002).

Social Judgement theory, as a correspondence based approach which incorporates the environment within which clinical judgement takes place, offered a particularly appropriate approach to answering some of the research questions of this thesis. Nurses' cue usage when diagnosing leg ulceration could be examined by constructing a

double lens model for the diagnosis judgement and using regression analysis to express the relationship between the cues and the nurse's judgement. The construction of a double lens model for the treatment choice would allow the same approach to be used for examining nurses' cue usage for treatment choices. The accuracy of the nurses' diagnostic judgments and treatment choices could be evaluated by calculating the correlation between the ecological criterion and the nurse's judgement for both lens models. Cognitive control of judgement could also be evaluated by calculating the correlation between each nurse participant's judgement making model and their actual judgements. The relative importance of the information upon which such judgements are based could be considered by using multiple regression to calculate the relative weight of each information cue. Although the primary focus of Judgement Analysis is on idiographic data analysis, if such data meets statistical tests of regularity and dependability, the data can be aggregated to allow nomothetic comparisons to be made between a group of 'less expert' nurses and a group of more expert nurses. The impact of expertise on the judgement and decision making of community nurses could be assessed by comparing the achievement of each group of nurses.

However, Social Judgement theory is unable to capture cognition during judgement and decision making and therefore an adjuvant methodological approach was required to explore the cognitive processes used by community nurses when making clinical judgements and decisions about venous leg ulceration. Think Aloud techniques offered the best possible option for gathering such data complementing Social Judgement methodology to provide a form of between-method triangulation.

CHAPTER 5

METHODS

5.1. Study design

The plan of investigation was in two parts:

Firstly, in order to address the questions about how nurses used cues, the accuracy of their judgments and the impact of expertise, two Judgement Analysis tasks were constructed (Design 1). The first task addressed judgement for diagnosis while the second focussed on treatment choices regarding the selection of multi-layer high compression therapy.

The resulting data was used to inform two 'double system' Lens Models (Cooksey 1996) so that the performance of the nurses could be compared to an optimum ecology to evaluate the accuracy of the nurses' judgements. If the idiographic data was found to be sufficiently regular and dependable, then the performance of the group of expert nurses would be statistically compared to that of the group of less expert nurses, to explore any relationships between expertise and the accuracy of judgements..

Secondly, at the same time as the nurses undertook the Judgement Analysis tasks, Think Aloud techniques were used to collect concurrent data regarding cognition *during* judgement and decision making which was then analysed using protocol analysis (Design 2).

5.2. Ethical and research governance approvals

The Judgement Analysis task (Design 1) consisted of an online survey containing a series of patient case studies (based on the clinical notes of patients with leg ulcers) which required nurse participants to make a diagnosis and treatment judgement for each patient case study. This task required the recruitment of two groups of patient participants and one group of nurse participants:

Group A: Comprised patients with a diagnosis of either venous or mixed aetiology leg ulceration who had participated in the Venus II trial (an RCT undertaken by the University of York that tested the effectiveness of larvae therapy for patients with leg ulcers).

Group B: Comprised patients known to have a diagnosis of leg ulceration due to a cause other than venous leg ulceration and who were receiving care from a community nurse within the North and East Yorkshire Research and Development Alliance region.

Group C: Comprised registered nurses currently working as community nurses in North Yorkshire, who had recent experience in caring for patients with leg ulceration.

For groups B and C, written consent was sought from these participants before data collection took place. For Group A, the existing Venus II trial records included anonymised patient assessment records (each identified by an ID number) and so data collection for this thesis entailed retrieving data from existing research records and did not require any additional input from patients. The trial investigator (Professor Nicky Cullum) was willing for the Venus II data set to be accessed for this thesis but the consent form did not explicitly seek consent for this data set to be used in any studies other than the Venus II trial.

The Venus II trial team holds a master register linking their participants' contact details with the individual ID number of each record. Therefore, it would have been possible to approach each Venus II participant individually to seek individual written consent to access their information for this study. However, this would have broken the anonymity of the Venus II trial and, since many of the patients would be elderly or may have died, seeking written consent would have risked causing unnecessary distress. With this in mind (and since it was highly unlikely that an individual patient could be recognised from the clinical data held in their research assessment record) individual written consent for the use of this data was not sought. However, many of the nurse participants were recruited from within North Yorkshire so there was a possible risk that a nurse participant could identify a patient from their anonymised data. To minimise this risk the Venus II assessment records of patients recruited from the North Yorkshire locality were excluded from the sample.

The Think Aloud part of the study (Design 2) required six nurse participants to be observed and audiotaped while undertaking the first part of the Judgement Analysis task. These nurses were drawn from the Group C community nurse participants of Design 1 of the study. Written consent was sought from these nurses before they took part.

Following ethical approval from the University of York's Health Sciences Research Governance Committee (Appendix A), LREC ethical approval was received from York Research Ethics Committee (Appendix B). Local research governance approval was received for North Yorkshire and York PCT (Appendix C) and Sussex Community NHS Trust (Appendix D).

5.3. Design 1 – Judgement Analysis

5.3.1. Construction of the Scenarios

The judgement scenarios were drawn from a sample of real-life patient records from a pre-existing patient population with a leg ulcer (a lesion on their lower leg, superior to the heel, of any aetiology) who sought care from a community nurse. This approach, that uses cue values achieved through sampling from a pre-existing patient population, provides a higher level of representativeness within the research design (Cooksey, 1996d).

It was planned to include wound photographs in the judgement scenarios so that the cues would be presented in as similar way as possible to how they are presented in real life to increase representativeness (Cooksey, 1996c). Wound photography is widely but not universally used in clinical practice and it was possible that some clinicians only use wound photography for more unusual clinical presentations, which would constitute a less representative leg ulcer population. Therefore, patient populations were sought that had assessment records that routinely included wound photography for all patients with leg ulcers. The University of York's VenUS II trial data offered a relevant data set. The VenUS II trial was a pragmatic randomised controlled trial which had compared the effectiveness of larvae therapy to topical hydrogel dressings for healing sloughy leg ulcers. The trial had recruited patients with uncomplicated venous leg ulcers and

patients with ulcers due to 'mixed' aetiology (i.e. venous ulcers complicated by arterial disease). This trial data thus offered an anonymised data set of 267 assessment records which had both complete data for the cues for diagnosis and wound photography for a population of patients with leg ulcers due to venous and 'mixed' aetiology. However, since the VenUS II patient population did not contain enough patients with 'mixed' aetiology or any patients with unusual aetiologies, an additional population of such patients was needed. The patient assessment records of an NHS leg ulcer patient population in the north of England included such data and wound photography and thus offered an additional pool of patient records.

The reported diagnoses of the sample needed to match the proportions in the UK population so these proportions were calculated from the most recent UK prevalence surveys (Srinivasaiah et al., 2007, Vowden and Vowden, 2009). As discussed in Chapter 2 the prevalence figures for uncomplicated venous leg ulceration may be inaccurate but offered the most reliable data available. However, the literature defines the diagnostic criteria for uncomplicated venous leg ulceration but the diagnostic criteria for differentiating between ulcers of 'mixed' aetiology and those of 'arterial' aetiology is not clearly defined in the literature. Furthermore, both prevalence surveys had reported arterial foot and leg ulcers as one population which had probably inflated the proportion of 'arterial' leg ulceration. Given this uncertainty, the arterial and mixed venous/ arterial leg ulcer group were combined to constitute 36% of the sample. The original data was not available to assess whether there was normal distribution so the medians were calculated (Diamond and Jefferies, 2001) to decide the size of both the venous and the mixed /arterial groups. The surveys had not differentiated between 'other' and 'unknown' but only 5% of UK leg ulcers are thought to be due to more unusual aetiologies (King, 2004). Therefore, 5% of the study population was allocated to unusual aetiologies and the remaining 32% of 'unknowns/ others' were redistributed between the venous group and the mixed/arterial group in proportion to the diagnostic distribution of those groups (Table 5.1).

Table 5.1. Reported diagnoses proportions for the study population				
	Proportionate Distribution			
	Venous %	**Mixed/ Arterial %**	**Unusual %**	**Other /Don't know %**
Srinivasaiah N et al (2007)	38	24	n/a	38
Vowden K & Vowden P (2009b)	40	24	n/a	36
Medians	39	24	n/a	37
Adjusted Proportions for study population	59	36	5	

Identifying the relevant cues

Each judgement scenario sought to present the nurse informant with a collection of cues to be used to reach a judgement about diagnosis and a judgement about treatment with regard to compression bandaging. The decision as to which cues to present within the judgement scenario was informed by evidence-based prescriptive ideas of what nurses should be considering when diagnosing a leg ulcer (as outlined in Chapter 3). It is possible that nurses making leg ulcer diagnoses use cues other than these and this is considered within the analysis of the resulting data.

The choice of cues for judgement for treatment was drawn from the literature explored in Chapter 3. Since these cues were drawn from qualitative research that sought to identify all the factors that influenced decision making for treatment of leg ulcers, it was less likely that any significant cues were missed. Again, the possibility that nurses use cues other than these is considered within the analysis of the resulting data.

Number of cues

Cooksey argues that the number of cues in each judgement profile should ideally be kept within a range of 7 (±) cues (Cooksey, 1996c). This argument is based on Miller's suggestion that the human short term memory appears to be capable of actively coping

with only 7 (± 2) *bits* of information at one time (Miller, 1956). However, subsequent research into this subject has shown that other factors affect the apparent capacity of the short term memory such as sound length, the way in which information is presented (eg visually or orally) or whether the information can be 'chunked' (grouped into 'chunks' of related cues) (Jones, 2002). Some Judgement Analysis studies have ignored Cooksey's recommendation of limiting the range of cues to 7 (± 2) and used up to 64 cues (Roose and Doherty, 1976). A review of Judgement Analysis research found that even when a large number of cues were available, fewer than 10 cues were typically utilised. There was some consistency in the number of cues utilised but there was variation as to which cues were included in the subsets (Brehmer and Brehmer, 1988). These findings are supported by research that investigated a broad range of social topics which contained between three and 19 cues (Gigerenzer et al., 2002). The average number of cues utilised ranged between 2.2 and 7.4 cues but accuracy did not improve in relation to an increase in the number of cues utilised.

In real life wound care practice, clinicians are likely to have to manage more than 7 (±) 2 cues when making a diagnosis or treatment judgement. These cues may be presented sequentially rather than simultaneously (e.g. a Doppler assessment of ABPI may follow an initial visual examination) or be constantly available for checking (e.g. the colour of the wound or the ABPI measurement which is visible through being recorded in the patient's notes). Consequently, the issue of short term memory was less important and limiting the number of cues presented to 7 (±) 2 cues would have been an inappropriate restriction since the nurse informants would not need to retain these cues in their memory. In order to adhere to the principles of representative design, the nurse informants were presented with the usual breadth of information that would be present in real life clinical practice and allowed to select whichever cues they wanted to inform their judgement.

Although, all relevant and available cues were presented in each scenario, the 38 cues for diagnostic judgement (Table 5.2.) identified from the literature search (see Chapter 3 p54) were categorised into six cue groups so that the data could be operationalised in a way that was more amenable to statistical analysis. These cues were initially all operationalised within the scenarios using data from the original patient records.

Table 5.2.

Operationalised cues relating to diagnosis of uncomplicated venous leg ulceration

Cues	Diagnostic Predictor	Indicators
Medical history	Venous Disease / Damage	Varicose veins
		Previous VLU
		Phlebitis
		Trauma in relevant leg (such as surgery, fracture or trauma)
	Arterial Disease	Heart disease
		Stroke
		TIA
		Diabetes
		Peripheral vascular disease
		Cigarette smoking
		Rheumatoid arthritis
		Night cramps
		Rest pain in leg
		Intermittent claudication
Position	Suggestive of venous disease	Gaiter / malleolus area of leg
	Suggestive of other disease	Not on gaiter/malleolus of leg
Clinical appearance of lower limb	Visible signs of venous disease on lower limb	Eczema / dermatitis
		Ankle flare
		Varicose veins
		Lipodermatosclerosis
		Hyperpigmentation
		Atrophe blanche
	Visible signs of disease other than venous disease on lower limb	Hair loss
		Taut shiny skin
		Gangrenous toes / tissue necrosis in lower foot
		Oedema
		Dependent rubor
		Pale or blue feet
		Depth
		Punched out
		Poorly perfused wound bed
		Rolled edge
		Cauliflower appearance
		Raised ulcer bed
Pain	< Pain - arterial	Pain scale score
Age	Venous hypertension associated with advanced age	Date of birth – age in years
ABPI	<0.8 >1.2	Clinical test

However, inspection of the data revealed that there was no variation with regard to the cue of position of ulcer since all patient participants had ulceration on the ankle/ malleolus or gaiter area of their leg. Therefore, this cue was omitted from the analysis.

26 possible cues for decision making for the treatment of leg ulceration were identified from the literature search. There was limited robust evidence to identify those of particular relevance (See Chapter 3) so it was necessary to decide which cues should or could be operationalised within the Judgement Analysis task. The 26 individual cues were also sorted into groups of related cues so that the data could be operationalised in a way that was more amenable to statistical analysis (Table 5.3.).

Previous research has found '*clinician confidence'* to be closely linked with the indicators of 'expertise' (i.e. knowledge/ expertise, experience, education and autonomy) (Adderley, 2005). The influence of expertise is explored using qualitative methods (Design 2) but each nurse informant was asked to indicate their level of confidence (on a Likert scale) about each judgement they made during the Judgement Analysis task.

Nurse's knowledge is a key issue in relation to why such a large proportion of care does not appear to be in line with research findings (as discussed in Chapter 3). However, *nurse's knowledge* is difficult to operationalise within a Judgement Analysis task since a level of knowledge from a variety of sources will be inherent within all the nurse participants. Although new knowledge could be presented as part of the Judgement Analysis task (for example, by reminding participants of the research-based recommendations of clinical guidelines) this would compromise representativeness since real world clinical practice does not currently contain such pertinent reminders. Therefore, the cue of *nurse's knowledge* was not operationalised within the Judgement Analysis task but the qualitative methods used alongside the Judgement Analysis task were expected to provide some useful data on knowledge use.

Other cues could not be operationalised for a variety of reasons. The statistical requirements of the judgement task required the nurse judges to be provided with a list of treatment choices, which meant that these products were all viewed as available. Therefore, the cue of *availability of products* could not be operationalised. The cue, *cost of products to the patients* was not operationalised since it is not highly significant

in the UK, as most patients with leg ulcers are elderly and thus entitled to free prescriptions. (Those not entitled to free products can obtain supplies at very low cost through the purchase of a pre-paid certificate which then exempts them from further prescription charges.)

Table 5. 3. Cues relating to treatment	
Cues	**Sub-categories**
Clinician confidence	Clinician confidence
Nurse's knowledge	Research based knowledge Experience based knowledge Original Research Local Guidelines Colleagues' opinions Product Info / Advertising Patient related information General reference works
Availability of products	Availability of products
Cost of products to patients	Cost to patient
Cost to healthcare provider	Cost of products
Patient safety	Lives alone Communication ability Relationship with carers
Time	Staffing levels Time to make decision Time to deliver care
Diagnosis	Diagnosis
Pain	Comfort
Infection	Infection
Exudate levels	Exudate levels
Gender	Gender
Patient preferences	Social convenience Disturbance to patient Concordance

The cue of *cost to healthcare provider* was also difficult to operationalise. Nurses who are unaware of the comparative costs of different treatments will not give any weight to the cue of *cost* in their decision making. However, those who are aware of the comparative costs of treatments may consider this as an aspect of their decision making. In real life, cost information is available but must be either be retrieved from memory or sought from sources such as local formularies, the Drug Tariff (Department of Health, 2010) or labour cost databases rather than being overtly presented to the nurse at the time the decision is made. Although cost may be a factor in decision making for treatment, it was not possible to operationalise in a manner that did not significantly reduce representativeness. Therefore, *cost to healthcare provider* was not operationalised throughout the Judgement Analysis task. However, in the introduction to the Judgement Analysis task, the nurse participants were reminded that they could use the sources of information that they usually use in their everyday clinical practice (the Drug Tariff was named as an example). It was hoped that the Think Aloud might capture some data regarding *cost to healthcare provider* which could be considered in the qualitative analysis.

Patient safety also proved difficult to operationalise. The safe application of compression therapy requires the patient (or their representative) to be able to carefully monitor their comfort and seek clinical help should the treatment become difficult to tolerate. Discomfort alone is not necessarily an indication to remove compression (compression is often associated with discomfort (Briggs and Closs, 2006)) but it can indicate inadequate arterial supply which should prompt the removal or reduction of compression . An assessment of a patient's safety is a complex, multi-faceted judgement which proved impossible to capture in a meaningful way from the available patient data. Therefore, this cue was not operationalised but data was sought through the qualitative analysis.

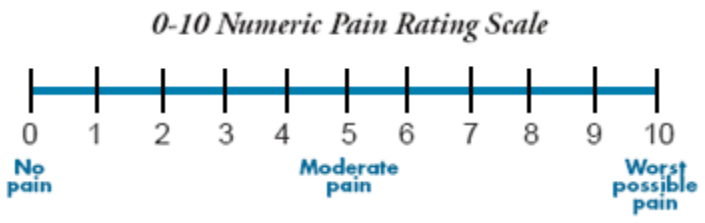
The cue *time to make decision* is relevant but leg ulcer diagnosis and treatment is not a clinical emergency. However, most patients, whether receiving care in a clinic or their own home, will expect the community nurse to provide them with a diagnosis and treatment plan immediately following initial assessment. Such judgements may be provisional (and require further reflection and discussion) but still constitute a judgement. Therefore, the electronic data collection tool required participants to make

the judgements for each scenario before proceeding to the next. However, there was no predetermined time limit per patient decision. Real life clinical practice time pressures were replicated by the participants being asked to complete the whole survey within one month. It was likely that since the nurse participants were either completing the survey in work time (i.e. actual work time pressures) or completing the survey in their own (presumably precious) time they would be working under similar time pressures to those in clinical practice.

Time to deliver care may affect judgement but is difficult to operationalise since the perception of available time to deliver care is inherent in the individual nurse judge. Nurse judges who are accustomed to having autonomy over the deployment of their time may have an inherently different approach to those nurse judges who are allocated specific time allowances for patient treatments. Therefore, rather than operationalise this cue within the judgement scenarios, the pre-survey questionnaire asked nurse participants to indicate how much time they usually allocated for a leg ulcer treatment. The remaining cues were operationalised, either individually or grouped together thematically (Table 5.3). *Diagnosis* was operationalised according to the individual diagnosis that each nurse participant made for each patient scenario based on the cues presented in that scenario. *Infection* was operationalised using the opinion of the patient's original nurse as to whether the wound was infected or not. *Exudate level* was operationalised based on the researcher's judgement of level of exudate based on the appearance of the wound from the wound photo. *Gender* was operationalised from data from the patients' original clinical records.

Pain was initially operationalised using the pain score recorded in the patient's clinical record in the form of a visual analogue scale (VAS) as shown below. (Fig 5.1)

Figure 5.1 Pain Scale



The pain literature notes that pain is a phenomenon with a range of characteristics so assessing pain only through the use of a VAS could be viewed as a reductionist approach. However, (as discussed in Chapter 2) although there is currently no evidence to indicate that qualitative pain information is a cue for diagnostic judgement, there is some evidence to suggest that pain scores may be linked with differential diagnosis. The inclusion of more qualitative information about pain might have increased the representativeness of the judgement task but this information had not been recorded in the VenUs II records. Therefore, the pain score offered the only available cue information regarding pain.

The survey tool software did not allow pain to be presented in the same visual format above so it was necessary to convert it into an actual score. Discussions with community nurses revealed that although nurses routinely use pain scales to assess pain, it is common practice to convert a mark on a VAS to the nearest whole number from 0-10 or to ask the patient to score their pain as a whole number from 0 -10. Therefore, presenting this data as whole number scores rather than as marks on a VAS did not threaten representativeness.

The pain scores for both the Venus II cohort and the NHS patient cohort were derived from marks on the VAS which had been converted into a score from 0-100. Initially, these pain scores were presented within the context of a 0-100 scale. However, during piloting of the data collection tool, it became apparent that the nurse participants were regularly misreading these scores. For example, a score of 9 which on a 0-100 VAS would indicate a low level of pain was being misread as a high level of pain as nurses used the 0-10 scale with which they were familiar. Therefore, the original 0-100 scores were transformed to a 0-10 score by dividing by 10 and correcting to the nearest whole number.

With regard to *patient's preferences in relation to bandaging* this was interpreted as a 'preference' rather than a 'refusal' since any patient who refuses compression cannot ethically be treated with compression. The data for this cue was taken from data within the original patient record for the NHS patient cohort. However, since one of the inclusion criteria for the VenUS II trial was willingness to wear compression, there was no variation for this cue within this cohort of patients. In a previous trial of compression bandaging (Nelson et al., 2004) 17% of patients screened were excluded

due to issues related to (or likely to be related to) willingness to wear compression. Therefore, if 17% of the VenUS II patients were selected to 'prefer not to receive compression" this would more closely emulate real life. However, there is a known relationship between pain and compression compliance (Briggs and Closs, 2006). Therefore, the VenUS II patients with pain scores ≤ 5 were excluded from this sample and 17% of the remaining Venus patients were randomly selected to 'prefer not to receive compression". The data about preferences for the patients from the NHS sample was obtained from the patients themselves by asking about their preferences.

Table 5.4.

Operationalised cues relating to whether to offer high compression

Cues		**Indicators**
Diagnosis	Venous	Diagnosis from Judgement Analysis
	Arterial	
	Mixed	
	Other	
Pain		Pain scale score from original patient record
Infection		If the wound appears infected - data from original patient record.
Exudate levels		Data from original patient record
Gender		Data from original patient record
Patient preferences in relation to compression (Social convenience / Disturbance to patient/ Concordance)		Data from original patient record (random sample of 17% of Venus II) sample) plus recorded preferences of NHS sample.

Development work for judgement profiles

The principal investigator for VenUS II at the Department of Health Sciences at the University of York was approached to seek their agreement to access the patient data. The tissue viability specialist nurses within North Yorkshire were approached to seek their agreement to access NHS patients.

Sampling for the judgement profiles

Statistical estimates are more precise when based on a large number of judgements (Cooksey, 1996d) but very large numbers of judgement profiles can have unintended Hawthorne effects as pressure from the volume of work, boredom, or impatience may affect the participants' judgement processes. Therefore, the challenge is to present participants with enough judgement profiles to enable the generation of stable regression estimates, without overloading and thus altering the judgement processes. An appropriate compromise is required between the statistical requirements of the study and the practical considerations in relation to the nurse judges.

The commonly cited recommendation for the sample size for the number of judgement profiles for Judgement Analysis studies using multiple regression analysis, is a minimum ratio of at least five judgement profiles to every cue used. A ratio of ten to one is preferred for the generation of stable regression estimates that can be generalised (Cooksey, 1996d). However, a recent Judgement Analysis study found that following a ratio of five profiles to one cue resulted in logistic regression models for individuals with large and unstable standard errors. The suggested solution was to use at least 10 observations for each option for each dichotomous cue in the model (Bland, 2008, Yang, 2009).

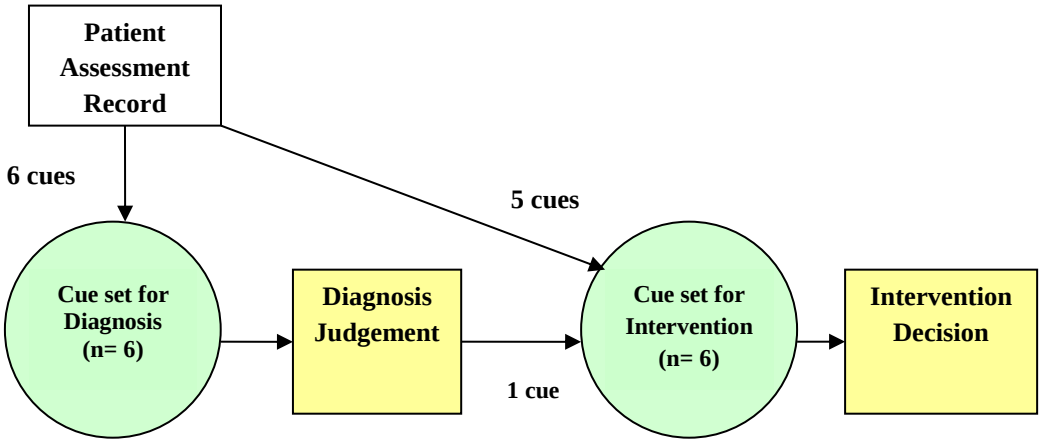
Alternatively, an analytical study which sought to identify the relationship between:

- the standard error or a particular's cue's regression coefficient
- the value of the multiple regression
- the extent of the cue intercorrelation (also known as collinearity) and
- the number of profiles

established that the standard error of a regression coefficient provides a measure of the potential stability of a model (Stewart, 1988). Stewart found that standard error estimates tended to stabilise at a minimum of around 50 profiles. As collinearity increases, the likelihood of precise regression estimates decreases, regardless of sample size. By contrast, as the strength of predictability (multiple correlation) increases, more precise regression estimates can be obtained. Therefore, Stewart used 0.10 as the maximum acceptable level of standard error to construct a table to calculate the minimum number of cases required for a multiple correlation of 0.90 depending on the level of collinearity.

In order to use Stewart's tables to calculate how many profiles would be required, it was necessary to identify both the number of cues that would be used and the likely level of collinearity in the final data set. The same patient scenario furnished both the diagnosis judgement profile and the treatment judgement profile with the diagnostic judgement, forming a cue for the subsequent treatment judgement (Fig 5.2). Although there was a total of twelve cues, as there were only six cues for the initial diagnostic judgement and six cues for the subsequent treatment choice, the sample size calculation could be based on six cues. This reduced the sample size and lessened the cognitive workload for the nurse judges. Using the same scenario for both judgements also had the added benefit of increasing representativeness, since in actual clinical practice each patient assessment situation requires a diagnostic judgement followed by a treatment choice.

Figure 5.2. Source of cues



The collinearity of an initial data set was evaluated to estimate the likely collinearity of the final data set, This data set consisted of 93 participants with leg ulceration (n = 67 uncomplicated leg ulceration, n = 22 mixed aetiology leg ulceration and n = 4 leg ulcers of unusual aetiology). Collinearity was evaluated using the SPSS 20.0 statistic package (IBM Corp, 2011). The outcome variable was the patient's reported diagnosis (expressed dichotomously as "uncomplicated venous leg ulcer" or not): the predictor variables were the diagnostic cues. This was repeated for the second judgement where the outcome variable was the treatment judgement (expressed dichotomously as "high compression' or "other treatment"): the predictor variables were the treatment cues. There was no evidence of significant collinearity for either the diagnosis judgement (r = 0.93 - 0.98) or the treatment judgement (r = 0.89 - 0.98). Therefore, using Stewart's tables (Cooksey, 1996c) a sample size of 110 judgement profiles was judged likely to achieve logistic regression models with sufficiently small and stable standard errors.

The inclusion of replicated profiles within the sample of judgement scenarios allows judgement consistency to be assessed. The repeated cases can be included within the total number of judgement scenarios (unless the study consists of a very small number of judgement profiles, i.e. less than 30 profiles) which avoids inflating the total judgement task (Cooksey, 1996d). Twenty replicated cases is recommended as sufficient (Cooksey, 1996d). Therefore, twenty replicated cases were incorporated within the judgement task which reduced the size of the sample to 90 patient assessment records. Together with the replicated cases, this provided a total of 110 patient scenarios, each of which contained two judgement profiles each requiring an individual diagnostic judgement and treatment judgement (Table 5.5.).

Table 5.5. Number of patient assessment records

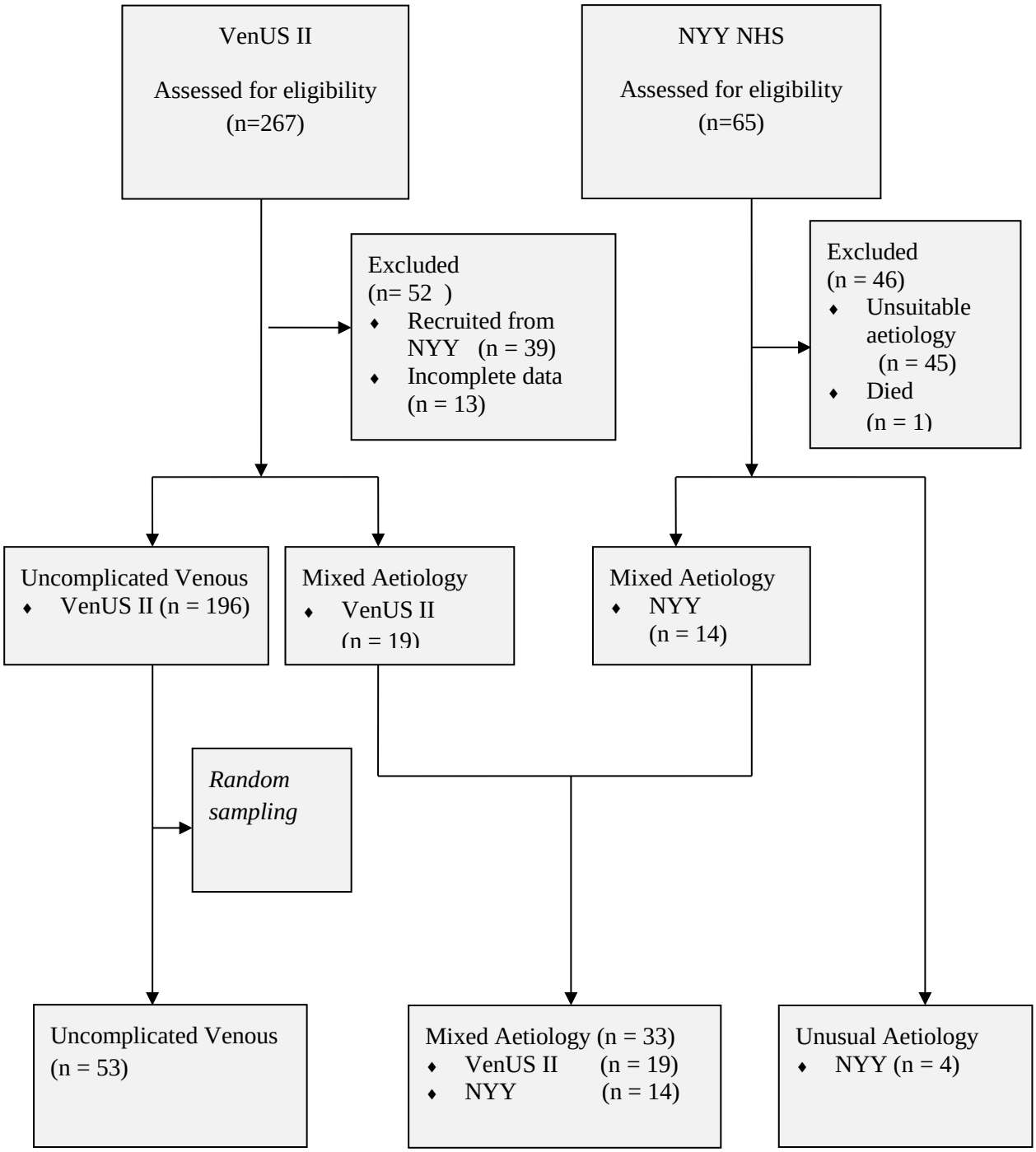
Total no of scenarios	No of scenarios minus replications	No of replications included	No of Diagnostic judgement profiles	No of intervention judgement profiles	Overall Ratio to Diagnostic cues (6 cues)	Overall Ratio to intervention cues (6 cues)
110	90	20	110	110	18.3	18.3

Sampling was based on the original diagnoses recorded in the patients' clinical notes and the relative proportions of different leg ulcer diagnoses reported in the literature. In order to optimise representativeness, the judgement scenarios needed to proportionally represent the different leg ulcer reported diagnoses (Table 5.1.) (Cooksey, 1996c). It was unlikely that this would be achieved with simple random sampling, as the available overall population of patient records was relatively small, which would be likely to result in sampling error (Bryman, 2001). The original intention had been to use stratified random sampling to achieve proportional representation of the different leg ulcer recorded diagnoses (as discussed in Chapter 2) but it was difficult to find sufficient patients with mixed aetiology and unusual ulcers to form sufficiently large strata from which to take random samples. However, the VenUs II patient population did offer sufficient patients with uncomplicated venous leg ulceration to allow random sampling for this diagnostic category. So random sampling was used to select a sample of patient records for patients with uncomplicated venous ulceration but purposive sampling (Bryman, 2001) was used to select samples for the other aetiologies in order to achieve a total combined sample that was within the parameters of the UK aetiological proportions.

Table 5.6. Sampling according to recorded diagnosis

Aetiology	**Venous**	**Mixed venous/ arterial**	**Other**	**Total**
Percentage of sample	59%	36%	5%	100%
No of records sampled	53	33	4	90
No of replications	12	7	1	20
Data Source	**Venus II data**	**NEY NHS**	**NEY NHS**	

. **Figure 5.3 Patient participant selection**



The VenUS II records included 196 records for patients with venous leg ulceration and 19 records for patients with mixed aetiology. To achieve a randomly selected uncomplicated venous ulcer sample, each Venus II uncomplicated venous ulcer assessment record was assigned a consecutive number from 1 upwards. A table of random numbers was used to select the appropriate number of assessment records.

To achieve the sample for the other aetiologies, all the Venus II mixed ulcer assessment records were included which gave 19 records. In addition, the North Yorkshire NHS Tissue Viability Specialist Nurses were asked to provide any patients in their locality with leg ulceration due to mixed aetiology or unusual aetiologies with a patient information letter (Appendix E). This letter sought those patients' written consent for relevant data from their notes to be extracted for use in this research (Appendix F). Patients with uncomplicated leg ulceration and those with other aetiologies but where data was missing and irretrievable or who were unable or unwilling to consent to participate in this study, were excluded. All other patients were included. For those that consented, the nurse was asked to use the information in the patient assessment record to complete the data retrieval form (Appendix G) which was then returned to the investigator along with a copy of the wound photograph and the signed consent form. In total, 70 patients with reported leg ulceration that was not thought to be uncomplicated venous leg ulceration were screened until sufficient patient records had been retrieved.

The number of cases for replication was calculated using the aetiological proportions to calculate the number required from each strata. These replication cases were selected by choosing those records that were first selected in each stratum, up to the number of replication cases required (e.g. for the venous ulcer stratum, the first twelve assessment records selected became the replication cases).

This final sample of patient assessment records formed the judgement scenarios of the Judgement Analysis task. These records were given an anonymous name and the clinical details within the assessment were written up in the form of a brief case study. An online random sequence generator (www.random.org/sequence) was used to generate the order in which the scenarios were to be presented. The generated sequence was checked manually to identify any replicated case studies that were presented in close proximity of their originals and these were moved to the end of the generated

sequence. All the case studies along with the wound photograph were then loaded on an online survey software package (Survey Monkey.com) to constitute the Judgement Analysis task.

Presentation of the judgement profiles

Social Judgement theory seeks to compare the judgements of individual judges about identical situations. It requires identical information to be presented in a manner that is as close as possible to the natural ecology. Identical situations do not recur in real life clinical practice, so the usual approach is to present the information as written case simulations in the form of 'case vignettes' or 'scenarios' (Cooksey, 1996c). These can be presented to the judges as either paper questionnaires or through a computer programme, since evidence suggests that both formats elicit the same responses from respondents (Schleutermann et al., 1983).

Presenting the judgement task in either of these formats is convenient but may not capture the way clinicians actually make their clinical judgements. Research evidence suggests that the main sources of information for nurses can be categorised as verbal, observational, written or based on prior knowledge but the frequency with which nurses use the different sources of information may vary in different clinical settings (Lamond et al., 1996b). Therefore, the source of the information and how it is presented will have implications for ecological validity, as a written case vignette may induce a different form of cognition from spoken or observational information and thus be less representative.

Alternative ways of presenting patient information have been used to try to more closely replicate actual clinical situations. For example, computerised human patient (physical) simulators have been used to provide replicable judgement scenarios. Significant differences in nurses' judgement performance have been found between written and physical simulations of clinical judgement tasks, with nurses' judgement reliability decreasing as the representativeness of the presentation of the information increases (Yang, 2009). It is likely that written case scenarios inflate judgement performance and thus simulators may offer a superior approach to replicating judgement scenarios. However, although simulators have been adopted into nurse education for critical care

situations, simulators capable of simulating the cues relevant to chronic wound care do not yet exist and so were not available as a research approach.

Alternative methods for presenting the relevant observable cues in a visual form were considered. Re-enactments using real patients were not an option, since such re-enactments cannot be reliably replicated. Filmed patient scenarios have been used in clinical decision making education (Kitson-Reynolds, 2009) but while these have the benefit of being reliably replicable, asking nurse judges to make the required number of judgements using this approach would be prohibitively time-consuming. Wound photography offered a possible compromise between representativeness and the time constraints of the Judgement Analysis task. Although photography has been used in studies examining decision making in dentistry (Zadik and Levin, 2008) and scoliosis (Donaldson et al., 2007) no clinical studies were found that used photography within a Judgement Analysis methodology. Wound photography is an established part of tissue viability practice in the UK (Fletcher, 2008) so clinical judgement using photography is familiar to most nurses. Since many of the cues for diagnosis are visual, wound photography can present visual data within the judgement scenarios in a manner that more closely resembles the natural ecology. Photography has been used in Social Judgement research studies as a useful means of increasing representativeness (Cooksey, 1996c) and therefore offered a useful approach in this study.

The cues were presented within the scenario in as similar manner as possible to the way in which these would usually be encountered within the ecology. Each sampled patient assessment was used as the basis for a written individual patient judgement scenario that included a judgement profile for diagnosis and a judgement profile for treatment. Judgement tasks that are framed in a familiar manner for nurse judges and accompanied by instructions phrased in terms sensitive to the judge's level of expertise are more likely to achieve outcomes that are valid, replicable and more generalisable beyond the boundaries of the research (Cooksey, 1996c).

A high level of task congruence was achieved through using the naturally occurring measurement units of information. For example, an actual ABPI measurement is a naturally occurring unit of measurement, whereas translating an actual ABPI measurement into an abstract concept such as 'low' 'medium' or 'high' would be an abstract representation of this information. This level of task congruence was achieved

for visual cues (such as the appearance of an ulcer or limb) by presenting them in the form of a colour photograph. The judgement task used technology that allowed the participants to complete it in several sessions, rather than in one session. Since this mirrored the pace at which diagnosis and treatment judgements happen in clinical practice, this was acceptable. In order to collect data about nurses' confidence about their diagnoses and treatment choices, each scenario also asked the participants to rank their level of confidence about the 'correctness' of each diagnostic judgement and treatment judgement using a Likert scale. A score of '0' indicated 'no confidence' while '10' indicated certainty. An example of how the online scenarios appeared to the nurse participants is shown in Appendix H.

Pilot study

A pilot study of the data collection tool was carried out using 2 non-specialist community nurses who fitted the inclusion criteria for the nurse participants. These nurse judges were initially asked to read the participant information sheet (Appendix I) and then complete a consent form (Appendix J). Upon receipt of the completed consent form and questionnaire, they were e mailed a unique identification number, a password and the e mail address of the website which carried the expertise survey and the data collection tool (the Judgement Task). The participants were then asked to complete the expertise survey, the judgement task and asked to identify any technical problems experienced during completion of the survey. This survey also sought the participants' views as to the 'weightiness' of the judgement task. The responses of this second survey were used to modify the design of the data collection tool in terms of how the pain data was presented (as described on p 102). Data retrieval and input into the statistics package (SPSS) was tested but no problems were identified.

5.3.2. The nurse participant sample

Development work for the nurse participants

The community nurse managers and GP practice managers were approached within the North Yorkshire primary care organisations to seek their agreement to access community nurses. The tissue viability specialist nurse community were approached through a professional interest group (The North East Tissue Viability Group). All participants were promised anonymity.

Sampling the nurse judges

This thesis explores how community nurses who care for patients with venous leg ulceration as a regular part of their clinical role, make diagnoses and treatment choices about this area of care. Since this Judgement Analysis was carried out in a Cell A context (see Chapter 4, Fig 4.1) the sample required nurse judges who delivered leg ulcer care in a community setting. For the purposes of this study, this was defined as a registered nurse who was either responsible for the care of at least one community-based patient with leg ulceration at the time of the research, or who had been responsible for the care of at least two patients within the previous three months. The NMC Code specifies that a registered nurse should "recognise and work within the limits of your competence" and "be personally accountable for actions and omissions in your practice and must always be able to justify your decisions" (Nursing and Midwifery Council, 2008). This implies that a registered nurse who accepts responsibility for the care of such patients is practising within a Cell A context. However, although all the nurse judges fell into Cooksey's 'Cell A' category in that "they had made these sorts of judgements before in real life" (and continued to make these sorts of judgements in their current clinical practice) it was still likely that there would be variations in levels of expertise which might have impacted on decision accuracy.

The uncertainty regarding defining contributing factors towards expertise (which might be associated with intelligence, experience, organisation of knowledge and education and unknown others) was discussed in Chapter 3. It was noted that expertise can be

examined from two different approaches: the *relative* approach and the *absolute* approach. A *relative* approach was used to segregate 'more expert' nurses from 'less expert' nurses through their role in relation to leg ulcer care. Data was collected from an equal number of generalist community nurses (such as practice nurses and district nurses) and community tissue viability specialist nurses. The generalist nurses were classified as 'less expert' while the specialist nurses were classified as 'more expert'. However, in addition, data was collected from all participants about those factors for which there is evidence to suggest possible relevance to both nurses' decision making (Thompson, 1999b) and expertise (Lamond and Farnell, 1998, Lauri and Salantera, 2002, Hoffman et al., 2004, Ashton and Price, 2006).

The factors relating to expertise were operationalised as follows. *Length of experience* could be estimated in an objective manner in terms of both years of experience within the clinical field and time (as a proportion of the working week) currently spent delivering leg ulcer care. *Level of education* was estimated in terms of the level of tissue viability educational events/ courses attended. *Knowledge* and *expertise* were more difficult to operationalise since they depended on self-reporting. Self-reporting was likely to lack reliability or validity, due to the risks of poor insight, self-deprecation, social desirability or self-aggrandisement. Therefore, proxy indicators were used for these more intangible variables. These proxy indicators included degree of specialism (as revealed by whether the nurse judge delivered care within a specialist service such as a leg ulcer clinic or as part of a generalist caseload), seniority (as revealed through job title) and degree of clinical autonomy (as revealed through control of clinical time available, freedom to allocate clinical time and whether the nurse participant was unable to prescribe, or held a nurse prescriber or non-medical prescriber qualification). Finally the nurse judges were asked about how they thought they were viewed by their peers in terms of their level of expertise in leg ulcer care. Although this approach relied on self-reporting with its attending risks, it was hoped that asking the respondents to imagine reporting their level of expertise through the eyes of their peers might reduce these risks.

Sample size for the nurse participants

Judgement Analysis is an idiographic approach to studying judgement, in that it aims to capture the judgement policy of an individual judge. If this is the sole purpose of the research then this can be achieved with very few participants (Cooksey, 1996c). However, this thesis sought to discover whether community nurses with expertise in leg ulcer care differ in their accuracy and cognition to less expert community nurses. Therefore, the sample of nurse participants needed to be sufficiently large to detect such a difference.

The sample size calculation for seeking to identify whether there is a difference between the mean accuracy of two groups of nurse participants takes into account the required mean difference between the two samples, the probability that this difference could be detected (i.e. the power of the test) and the variability (variance) of the difference in decision accuracy (Bland, 2000b).

$$(\boldsymbol{\mu_1 - \mu_2})\,\mathbf{2} = \boldsymbol{f(\alpha, P)\sigma^2}\left(\frac{\mathbf{1}}{\boldsymbol{n_1}} + \frac{\mathbf{1}}{\boldsymbol{n_2}}\right)$$

(Bland, 2000b)

$(\boldsymbol{\mu_1 - \mu_2})$ = mean difference between the two samples

$\boldsymbol{n}$ = sample size

$\boldsymbol{f(\alpha, P)}$ = relationship between Power and significance level

$\boldsymbol{\sigma^2}$ = variance of the measurements

The standard significance level of 0.05 and a power of 0.9 were chosen to give a high probability of detecting a difference should one exist. A previous Judgement Analysis study (Thompson et al., 2008) which had compared the judgements of nurses with varying levels of education (one of the components thought to contribute to expertise) was used to furnish variance data. This study had compared the agreement between groups of nurses with different levels of academic achievement in terms of correlation

coefficients (Ra). The mean correlation coefficients for each group of nurses were pooled to calculate an overall mean correlation coefficient (0.40). Correlation coefficients are 'bounded' between +1 and -1 and do not have a normal distribution required for the parametric tests which are used to analyse correlations between groups. Therefore, this pooled mean was transformed using Fishers Z transformation to give a normal distribution with a mean of 0.42 (SD 0.19). This data was used to furnish the sample size calculation which was calculated using Clinstat software (Bland, 2010).

The sample size calculation also required data regarding the size of effect being sought. (i.e. the difference in the percentage of the total variance explained by expertise). The previous Judgement Analysis study had found no significant difference in the accuracy of decision making between the groups of nurses with different levels of education. However, the large sample size that would be required to detect no difference (or a very small difference) was likely to be beyond the resources of this thesis. For example, 264 nurse informants would be required to detect a difference in effect size of 0.02 (using a significance level of 0.05 and a power of 0.9). More importantly, the detection of a small difference would be unlikely to lead to organisational change in terms of investment in those factors believed to foster expertise. Therefore, a medium to large difference in effect size of 0.2 (Cohen, 1988) was used to inform the sample size equation. This along with a significance level of 0.05 and a power of 0.9 resulted in a desired sample size of thirty eight participants with 19 participants in each group.

Purposive sampling (Carter and Henderson, 2005) was used to select the sample of nurse participants. A *relative* approach was used to segregate 'more expert' nurses from 'less expert' nurses through their role in relation to leg ulcer care, in order to sample similar numbers of informants in each group. Generalist community nurses (such as practice nurses and district nurses) were classified as 'less expert' and community tissue viability specialist nurses as 'more expert'.

Nurse participants were sought through contacting tissue viability nurses, community nurse managers and GP practices by letter and e mail. Those willing to participate were asked to read the participant information sheet (Appendix I) and to complete the consent form (Appendix J). Upon receipt of the consent form, each nurse participant was e mailed a unique identification number, a password and the e mail address of the online

expertise questionnaire. Following completion of this questionnaire, each nurse participant was emailed the address of the website which carried the data collection tool.

The nurse participants were asked to complete the Judgement Task within one month of receiving their identification number in order to guard against maturation Nurses who consented, but then failed to complete the survey within one month of consenting, received polite weekly email reminders up to eight weeks after consenting. When recruitment was poor, nurse managers received a polite communication by telephone, letter or email reminding them of the study and asking them to encourage their staff to participate. With their permission, nursing teams were contacted again by telephone, email or letter and asked for their assistance.

5.3.3. Data to inform the ecology

With regard to cues, the same data as had been used for the 'judged state' side was used to furnish the 'ecology' side of the Lens Model. However, while the 'judged state' side of the Lens Model used data taken from the nurse participants' judgements, the 'ecology' side required data that allowed it to act as an optimal comparator against which to compare the performance of the nurse informants.

One option was to use the original diagnoses and treatment judgements of the patient assessment records. This had the advantage of being highly representative of real life, with the added benefit that all the patients had received diagnoses and treatment judgement from a nurse who was aware of the Venus II trial inclusion criteria (which were based on the underpinning evidence regarding venous ulceration as outlined in Chapter 2). However, these diagnoses had been made by a range of nurses with a variety of skills, knowledge and information and it was possible that some of these diagnoses were inaccurate. This uncertainty potentially threatened the reliability and validity of the results. The diagnoses of mixed aetiology ulceration and some of the more unusual causes of leg ulceration do not have such specific, evidence based diagnostic criteria. Therefore, the chance of inaccuracy for these diagnoses was even greater, but since this study was focussing on accurate diagnosis for uncomplicated venous leg ulceration only, the uncertainty about these other diagnoses did not threaten the reliability and validity of the results.

An alternative approach would have been to decide the diagnoses and treatment judgements according to strict evidence based criteria, as outlined in recognised national clinical guidelines for venous leg ulceration (Royal College of Nursing, 2006). This approach offered the advantage of providing diagnoses and treatment judgements that were robustly in line with current evidence based guidance for uncomplicated venous leg ulceration. However, this approach would also have been less representative than using the original diagnoses and treatment judgements.

A more representative and accurate approach would be to use the diagnoses and treatment judgements of actual nurses with recognised expertise in managing leg ulceration. Uncertainty in clinical care has traditionally been managed through relying on the opinion of an expert, although the opinions of such people cannot be regarded as 'the truth' but rather as the best available gold standard. The potential flaws associated with relying on a single opinion can be minimised through group decision-making approaches such as consensus development methods (Black, 2006). Consensus development methods aim to measure and develop consensus through identifying all the relevant issues, framing these issues in the form of explicit statements and then obtaining a statement of the level of agreement within the group through the use of a Likert scale. Nominal group techniques (also known as the 'expert panel' approach) aim to achieve this through obtaining individual judgements which are aggregated then finalised following group discussion. Delphi surveys follow a similar format but without the group participants meeting: any changes are in response to being informed of other participants' views rather than following discussion (Black, 2006). Consensus development methods are usually applied to health care problems where there is conflicting scientific evidence and potential for vested interests, which requires the input from a variety of stakeholders (Jones and Hunter, 1995). Agreeing an optimal diagnosis and treatment judgement for each patient scenario is a more narrow issue than those issues typically addressed by consensus development methods, but the principles upon which consensus development methods are based, offered a robust approach to achieving such data.

An expert panel was convened consisting of four community tissue viability specialist nurses from four different healthcare organisations with advanced knowledge and experience in managing uncomplicated venous leg ulceration. All members of the

expert panel had been actively involved in the VenUS trials and had at least two years specialist nursing experience in managing leg ulceration in a community setting. Since the issue under question was a clinical question relating to accuracy that only required the viewpoint of clinicians, it was not appropriate to widen the membership of the group. Although this was a small group of experts, a systematic review of consensus development methods found that clinical specialists with similar levels of expertise will come to similar judgements regardless of the size of the group (Hutchings and Raine, 2006). Therefore, four experts were considered adequate for this task.

The principles of consensus development methods include the provision of independent evidence, privacy, the opportunity to change views and an explicit and transparent derivation of the group's decision. The participant experts were asked to independently complete the online survey before the consensus meeting date. This data was examined by the author in advance of the meeting, in order to identify areas of consensus and disagreement.

At the consensus meeting, the panel were presented with each patient scenario in turn and informed of the range of individual answers that they had given prior to the meeting. Following discussion a group answer was agreed for each scenario and input into the online data collection using a unique ID. This data formed the 'optimal' diagnosis and treatment judgements against which the nurse participants' diagnoses and treatment choices would be compared in the lens models. The panel were also asked to indicate their group level of confidence for each diagnosis and treatment judgement. The data from individuals generated before the consensus meeting was included within the nurse participant sample. As this data was gathered before the consensus meeting there was no risk that this individual data could be affected by the consensus group discussion.

5.3.4. Data analysis

Treatment of the data

In order to ensure privacy and confidentiality, the data collection tool encrypted the data transmitted between the data collection tool and the researcher's university account where the data would be analysed. Upon receipt of data, the nurse participants' demographic data, the judgments of the nurse participants and the cue values from the patient assessment record for each patient were extracted. Ratio cue values which were measurable in their original concrete measurable units were used as the actual cue values. Ordinal cue values that had no natural units of measurement were measured using an abstract 0-10 scale. For example, pain was measured using a pain scale from 0 – 10 where '0' indicated 'no pain' and '10' indicated 'worst pain imaginable'. Nominal cue values were numerically coded (Tables 5.7, 5.8 and 5.9). The original measurable ratio unit of the ABPI cue is linear but was re-coded as a dichotomous value (Table 5.8). Since incomplete data could adversely affect the data analysis through increasing the risk of large standard error, only participants who had fully completed both stages of the Judgement Task were included in the analysis to ensure complete data.

In order to achieve a higher level of 'representativeness' (as discussed in Chapter 4) the dependent variables for both the diagnosis and treatment judgement were presented to the nurse participants as categorical dependent variables with more than two categories. However, the research questions of this thesis focus on the diagnosis and treatment of venous leg ulceration, rather than exploring the diagnosis and treatment of all forms of leg ulceration for which there is less robust research evidence. Differential diagnosis requires a dichotomous decision (i.e. it either is or is not a particular condition) as there is no logic in the concept of a diagnosis that is 'almost right' since mistaking a mixed aetiology ulcer for an uncomplicated venous ulcer could result in harm through inappropriate treatment (e.g. applying high compression to an arterially compromised leg would be likely to cause harm) (Doughty et al., 2000).

Table 5.7 Coding of nurse participant demographic data		
Datum	**Type of data**	**Data Value / Coding**
Years of Nursing Experience	Nominal	1 = 0-2 years 2 = 2-5 years 3 = 5-10 years 4 = >10 years
Area of Practice	Nominal	1 = Practice Nursing 2 = District Nursing 3 = Both of above 4 = Other
Nursing Qualification	Nominal	1 = EN 2 = RGN/RN 3 = Post reg. community nursing qualification 4 = Nursing degree 5 = Post grad degree
Nurse Prescriber	Nominal	1 = No 2 = Nurse Prescriber 3 = Non-Medical Prescriber
Gender	Nominal	1 = Female 2 = Male
Age	Interval	Age in years
Leg Ulcer Experience	Interval	Length of time in years
Leg Ulcer Education	Nominal	1 = None 2 = Workplace – pharmaceutical company 3 = Workplace – TVN 4 = Study day – pharmaceutical company 5 = Study day – TVN 6 = Study day – TV organisation 7 = Study day – University 8 = Diploma 9 = Degree 10 = Masters 11 = PhD
Job Title	Nominal	1 = Staff Nurse 2 = Sister 3 = Team leader 4 = TV Specialist Nurse
Hours per week on leg ulcer care	Interval	Length of time in hours
Hours per week employed as a nurse	Interval	Length of time in hours
Setting for leg ulcer care	Nominal	1 = Patient's home 2 = GP practice 3 = LU community clinic
Level of supervision	Nominal	1 = Always 2 = Usually 3 = Sometimes 4 = Occasionally 5 = Rarely / Never
Level of expertise	Nominal	1 = New 2 = Basic skills 3 = Some skills 4 = Considerable 5 = Advanced 6 = Expert
Level of allocated time	Interval	1 = 10 2 = 20 3 = 30 4 = 40 5 = As long as is needed

Table 5.8 Coding of data relating to diagnosis		
Datum	**Type of data**	**Data Value/Coding**
Medical History	Nominal	1 = History of Venous disease only 2 = History of Arterial disease only 3 = History of venous and arterial disease 4 = No history of venous or arterial disease
Position	Nominal	1 = Gaiter or malleolus 2 = Not gaiter or malleolus
Clinical appearance of lower limb	Nominal	1 = Signs of venous disease 2 = Signs of arterial disease 3 = Signs of disease other than venous or arterial 4 = No signs of any disease 5 = Signs of both venous and arterial disease 6 = Signs of both venous and other disease 7 = Signs of both arterial and other disease
ABPI	Nominal	0 = Indicative of significant arterial disease (<0.8 or >1.2) 1 = Not indicative of significant arterial disease (>0.8 &<1.2)
Pain	Ordinal	Pain scale score where 0 = no pain at all - 10 = worst pain imaginable
Age	Ratio	Age in years
Confidence	Ordinal	Likert scale where 0 = No confidence – 10 = Completely confident

Table 5.9 Coding of Treatment Data		
Datum	**Type of data**	**Data Value / Coding**
Diagnosis	Nominal	1 = Uncomplicated venous leg ulceration 2 = Mixed venous 3 = Arterial ulceration 4 = Unknown other
Pain	Ordinal	Pain scale score where 0 = no pain at all - 10 = worst pain imaginable
Infection	Nominal	1 = Infected 2 = Not infected
Exudate levels	Nominal	1 = Minimal exudate 2 = Moderate exudate 3 = Heavy exudate
Gender	Nominal	1 = Male 2 = Female
Patient preferences in relation to bandaging	Nominal	1 = Prefers no compression 2 = Accepts compression

The lack of evidence for the diagnosis and treatment of other types of leg ulceration did not permit a similar level of research investigation into diagnostic and treatment accuracy for ulcers other than those due to uncomplicated venous insufficiency. Therefore, although the diagnostic judgement options were presented to the nurse judges as categorical dependent variables with more than two categories, the diagnostic judgement data was analysed as dichotomous dependent variables (Table 5.10)

Table 5.10 Categorisation of diagnostic judgement options	
Diagnosis options as presented to the nurse participants	**Categorised diagnosis options**
Uncomplicated venous	Uncomplicated venous
Mixed	Not uncomplicated venous
Arterial	
Unknown Other	

One potential complication was that although high compression is contraindicated for patients with a diagnosis of 'mixed aetiology' or 'arterial', it is an appropriate treatment for patients with lymphoedema whose diagnosis may have been categorised as 'unknown other'. However, since the number of diagnoses of lymphoedema was likely to be very small and thus unlikely to significantly impact on the results, all scenarios with a diagnosis of 'unknown other' were analysed as 'not uncomplicated venous leg ulceration'.

Similarly, the treatment decision options were presented to the nurse judges as categorical dependent variables but treated as dichotomous dependent variables (Table 5.11). The current evidence base supports the use of high compression for promoting healing of venous leg ulceration. As discussed in Chapter 2, the evidence suggests that it is reasonable to view the provision of any of the available graduated multi-layer high compression systems as an appropriate evidence-based treatment judgement. As there was no evidence to suggest the effectiveness of any other treatment for promoting healing of venous leg ulceration, this was the only treatment judgement for uncomplicated venous leg ulceration that was evaluated. 'Graduated multi-layer high compression' systems included all systems categorised as 'high compression' in the BNF (Royal Pharmaceutical Society, 2011).

Table 5.11 Categorisation of treatment judgements

Diagnosis options as presented to the nurse participants	**Categorised diagnosis options**
Four layer bandaging applied at recommended stretch	Graduated multi-layer high compression
Short stretch bandaging applied at recommended stretch	
Elastic two-layer compression bandaging (e.g. K-Two, Coban) applied at recommended stretch	
40mmHg compression hosiery (40mmHg at the ankle)	
"Reduced" compression bandaging (e.g. Four-layer, short stretch or two-layer bandaging reduced either by applying less stretch or by omitting one or more bandage layers)	Not graduated multi-layer high compression
Other compression hosiery (less than 40mmHg at the ankle)	
Other bandaging or hosiery with minimal or no compression	
No bandage or hosiery (i.e. dressing only)	

All the retrieved data from the patient assessment records was entered into SPSS for data analysis, with the information cue values for each patient record each occupying one column along one row. The 110 patient scenarios thus occupied a block of 110 rows in the data set. The judgement data of each nurse participant for each scenario was entered as a column in each patient scenario row. Therefore, each nurse's 'judgement' was organised in a block of 110 rows. Since only complete data was included, there was no need to manage any missing data and complete case analysis was applied.

Analysis of Idiographic Lens Model Statistics

As described in Chapter 4, the Lens Model Equation (LME) is used for examining judgements where there is one set of cues which requires one judgement. However, Multivariate and Higher Multivariate extensions of the LME exist for handling multiple or sequential decisions about a single cue set. In this thesis, although the cues for both the diagnosis and the treatment judgement were presented simultaneously (to achieve higher representativeness) the combined cue set did not form one simultaneous cue set since the first judgement ('diagnosis') formed a cue for the second cue set (for treatment); i.e. the second cue set was only complete once the first judgement (i.e. diagnosis) had been made. Therefore, the judgement tasks in this thesis were actually two judgement tasks from two overlapping cue sets. The Multivariate and Hierarcharchial Multivariate extensions of the LME were thus not required.

Cooksey's standard Lens Model equation uses standard least squares multiple regression and is applicable for Lens Models where the dependent variable (the judgement) is continuous. In this thesis, the dependent variables were dichotomous (i.e. 'uncomplicated venous leg ulcer? Yes /No' and 'multi-layer high compression? Yes /No') so logistic regression was a more appropriate approach (Cooksey, 1996e).

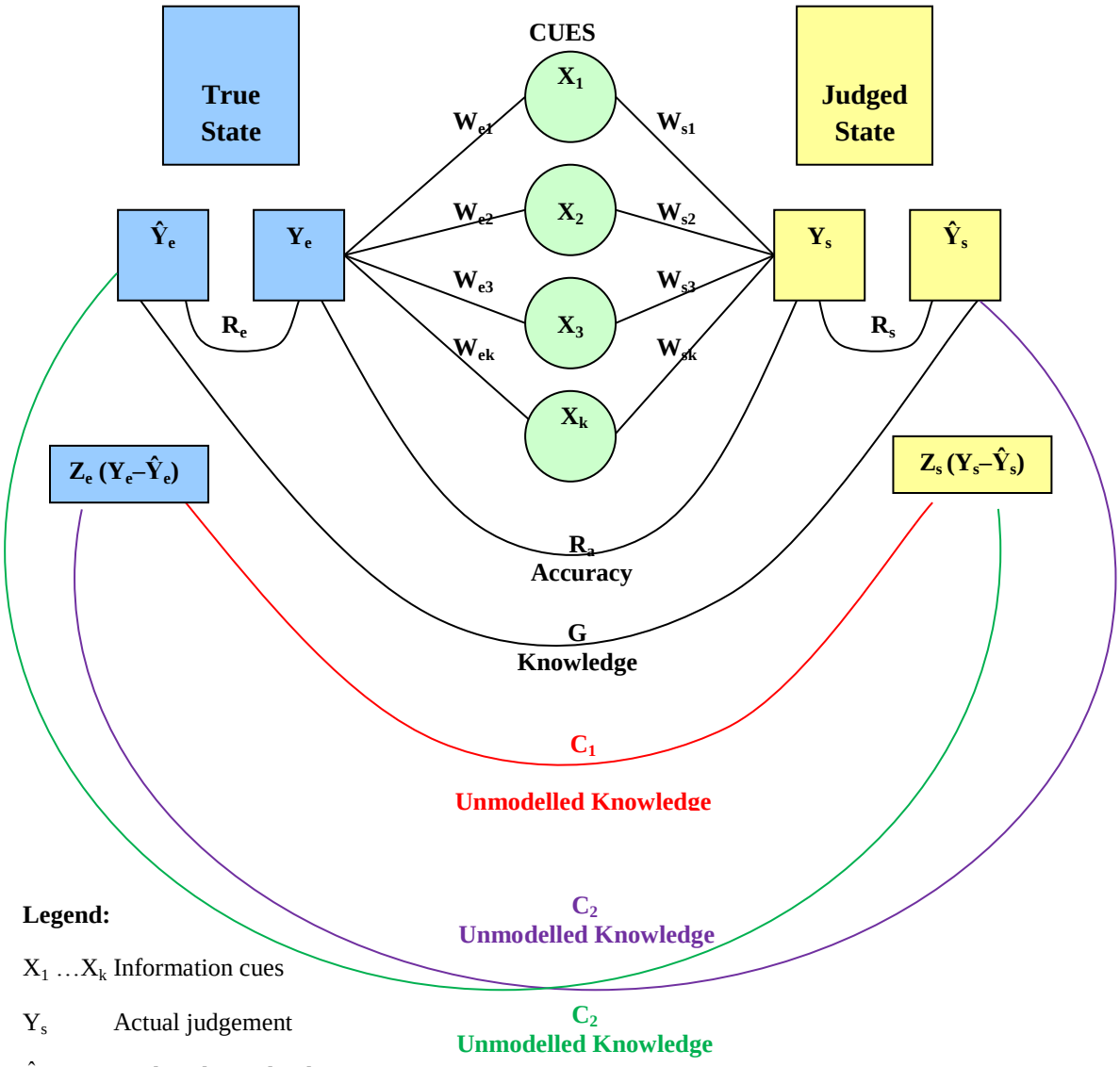
Logistic regression was used to develop equations that expressed the relationships between:

- each nurse participant's judged diagnoses and the diagnostic cues,
- the ecological criterion (the judged diagnoses of the expert consensus group) and the diagnostic cues, and
- each nurse participant's treatment choice and the treatment cues
- the ecological criterion (the treatment choices of the expert consensus group) and the treatment cues

Both the diagnosis cue set and treatment cue sets were simultaneously entered into a logistic regression model, since there was no evidence to support pre-specified ordering of cue entry (Cooksey, 1996a).

As described in Chapter 4, the Lens Model Equation presents achievement in terms of accuracy (R_a) as a function of knowledge (G), predictability (R_e), cognitive control (R_s) and unmodelled knowledge (C) (see Fig.4.3). However, Stewart noted that the Lens Model equation assumes that the variances for Y_e (true state) and Y_s (judged state) are equal to the sum of variances of prediction and residual. This is true for linear regression but not for logistic regression, when it is necessary to compute the variances of $\hat{Y}_e$ (the predicted judged value), $\hat{Y}_s$ (the predicted actual value), R_e (predictability) and R_s (cognitive control). Furthermore, Stewart argues that the Logistic Lens Model Equation requires a total of three nonlinear terms since the residual (Y_e-$\hat{Y}_e$ and Y_s-$\hat{Y}_s$) is not necessarily correlated with the prediction (Fig 5.4).

Figure 5.4. Logistic Lens Model for comparing the judgement policy of a nurse judge against an ecological criterion (Cooksey, 1996d)



Legend:

$X_1 \ldots X_k$ Information cues

Y_s Actual judgement

$\hat{Y}_s$ Predicted actual judgement

Y_e Ecological criterion value

$\hat{Y}_e$ Predicted criterion value

W_s Judgement weights

R_a Accuracy

R_s Cognitive control

R_e Predictability

G Knowledge

C_1 {

C_2 { Unmodelled knowledge

C_3 {

Stewart's revised formula addresses this issue (Stewart, 2004) and has been validated as accurate (Hamm, 2004, Yang, 2009).

The revised formula is:

$$R_a = G\frac{\sigma \hat{Y}_e \, \sigma \hat{Y}_s}{\sigma Y_e \; \sigma Y_s} + C_1 \frac{\sigma Z_e \, \sigma Z_s}{\sigma Y_e \; \sigma Y_s} + C_2 \frac{\sigma \hat{Y}_e \, \sigma Z_s}{\sigma Y_e \; \sigma Y_s} + C_3 \frac{\sigma Z_e \, \sigma \hat{Y}_s}{\sigma Y_e \; \sigma Y_s}$$

Ra continues to represent accuracy as the linear measure of correlation between the nurse participant's judgements and the ecology judgements.

$G\frac{\sigma \hat{Y}_e \, \sigma \hat{Y}_s}{\sigma Y_e \; \sigma Y_s}$ represents knowledge as the linear measure of correlation between the predicted judgement (perfectly consistent model) of the participants and the predicted criterion (perfectly consistent model of the ecology).

$C_1 \frac{\sigma Z_e \, \sigma Z_s}{\sigma Y_e \; \sigma Y_s}$ represents unmodelled knowledge as the correlation between the residuals of the two regression equations.

$C_2 \frac{\sigma \hat{Y}_e \, \sigma Z_s}{\sigma Y_e \; \sigma Y_s}$ represents the correlation between the predicted judgement of the ecology and residuals of the nurse participant's regression model.

$C_3 \frac{\sigma Z_e \, \sigma \hat{Y}_s}{\sigma Y_e \; \sigma Y_s}$ represents the correlation between the predicted judgement of the nurse participant's model and the residuals of the ecological regression model.

Logistic regression was used to generate a regression policy model for each nurse participant's responses to the Judgement Task of 110 scenarios. Each regression policy model generated a predicted diagnostic judgement ($\hat{Y}_s$) which was correlated with the actual diagnostic judgement (Y_s) to indicate the measure of cognitive control (R_s) for that scenario for that nurse participant. The regression policy model also generated a measure of the difference between the observed diagnostic judgement and the predicted diagnostic judgement (Y_s-$\hat{Y}_s$). Logistic regression was similarly applied to the ecology data to generate these statistics for the ecology side of the model.

The diagnosis judgement and treatment judgements were decomposed using Stewart's Logistic Lens Model equation. The correlations of the Lens Model indices (G, C_1, C_2, and C_3) were multiplied by the standard deviations of the actual values (Y_s and Y_e), the predicted values ($\hat{Y}_s$ and $\hat{Y}e$) and the residuals (Z_s and Z_e).

Nomothetic analysis of Lens Model statistics

The skewness and kurtosis of the diagnostic and treatment Lens Model statistics were considered in order to check whether the data met the assumptions of parametric tests (i.e. the data in each group had a normal distribution) (Bland, 2000a). The assumptions were met so parametric tests (Student's t test) were used to undertake nomothetic comparisons between the different groups of participants.

A larger proportion of tissue viability specialist nurses than generalist community nurses were more highly educated so it was possible that there was an interaction effect between job role and level of education. Sensitivity and specificity were calculated for both the diagnostic judgements and treatment judgements (Sackett et al., 1991) and two way repeated measures ANOVAs were conducted. The dependent variables were sensitivity and specificity and the independent variables were job role (tissue viability specialist nurse or generalist community nurse) and level of education (Field, 2005c).

Calculation of ideographic cue weights

In Judgement Analysis, the cue weights are used to indicate the importance of each cue in the judgement. Cue weights can be defined in a variety of ways. Originally, the correlation between the cue and the judgement (the validity co-efficient) was used as the cue weight, but this only accurately reflects cue importance when the cues are not inter-correlated. If the cues are inter-correlated, then the co-efficients will be systematically biased. Furthermore, since validity co-efficients ignore any cue redundancies (i.e. inter-correlations) the ecology is over-simplified and thus representativeness is reduced (Cooksey, 1996a). For example, if a nurse ignored whether or not the patient had a history of arterial disease and only focussed on the ABPI result, even though the history of arterial disease had no impact on their diagnostic judgement, the cue dependency (the validity coefficient) could be considerable, since the history of arterial disease is related to ABPI which has influenced the judgement. The importance of the history of arterial disease in this judgement might be non-existent, but its cue dependency could be sizeable.

An alternative option is to use multiple regression weights, since these incorporate the inter-correlations, providing the cues and judgements have sufficiently similar scales of measurement (as indicated by the size of standard error). Cue weights derived from multiple regressions indicate the contribution of each cue, in that the cue weight represents how much a judgement will change if that cue is increases by one unit, while all the other cues remain the same. However, if there is a high level of inter-correlations, then the accuracy of these regression weights will be uncertain. Furthermore, this approach requires the cues and judgments to have similar scales and measurements (as indicated by their means and standard deviations) in order to make meaningful comparisons (Cooksey, 1996a).

Another alternative approach is to consider the *relative* weights which are equivalent to there being 100 points to divide up between the cues, according to the predictable variation of each cue in the ecology (Cooksey, 1996a). For example, if the 'ABPI result' accounts for 50% of the diagnostic judgement, 'history of venous disease' for 25% and 'position of ulcer' for the final 25%, then ABPI would have a relative weight of 50, while 'history of venous disease' and 'position of ulcer' would each have a relative weight of 25. Although the accuracy of this approach requires the cues to not

be inter-correlated, this approach does offer a simpler way of presenting cue information to statistically-naïve people. Other approaches to cue weighting do exist (such as defining relative weights using the *usefulness coefficients* from the simultaneous regression models) but when the cues are uncorrelated then the relative weight approach offers an approach which is sufficiently accurate and conceptually more accessible.

Therefore, the diagnostic cue inter-correlations were calculated (Table 5.12). The cue intercollinearity was assessed by assessing the level of correlation between cues, the variance inflation factor (VIF) and tolerance statistics (Field, 2005d). Cohen's guideline was used to assess whether the correlations were low, medium or high. All the correlations were low with the exception of the correlation between medical history and ABPI which was judged as a medium correlation (Cohen, 1988). The VIF also assesses intercollinearity and shows the linear relationship of a cue with another cue (Field, 2005d). Values above 10 suggest a strong linear relationship but in this case, none of the VIF values were greater than 10. Tolerance statistics also measure intercollinearity and are calculated from the VIF (1/VIF) so that tolerance values below 0.1 indicate potential problems with intercollinearity (Field, 2005d). However, in this case these were all above 0.1. Therefore, overall, there was no indication of a level of diagnostic cue intercorrelation that would impair the accuracy of a relative weight approach.

Table 5.12 Diagnostic cue intercorrelations

Cues	**ABPI**	**Appearance of limb**	**Pain**	**Age**	**Medical History**	**VIF**	**Tolerance**
ABPI	1.00	- 0.02	0.06	-0.01	0.37	1.17	0.86
Appearance of limb		1.00	0.06	0.11	0.01	1.01	0.99
Pain			1.00	0.17	-0.03	1.04	0.96
Age				1.00	0.12	1.06	0.94
Medical History					1.00	1.17	0.85

Similarly, the treatment cue intercorrelations were also calculated. (Table 5.13)

Table 5.13 Treatment cue intercorrelations

Cues	Diagnosis	Pain score	Infection	Exudate Levels	Gender	Patient Preferences	VIF	Tolerance
Diagnosis	1.00	- 0.07	-0.03	0.04	-0.00	-0.10	1.02	0.98
Pain Score		1.00	- 0.15	0.11	0.20	0.12	1.10	0.91
Infection			1.00	-0.08	-0.14	0.16	1.08	0.93
Exudate Levels				1.00	-0.04	-0.11	1.04	0.97
Gender					1.00	0.01	1.06	0.94
Patient Preferences						1.00	1.07	0.93

None of the correlations were medium or large, none of the VIF values were greater than 10 and the tolerance values were all above 0.1 so there was no indication of significant treatment cue intercorrelation. Therefore, the diagnostic relative cue weights for each nurse participant were derived from the correlation coefficients (the beta values) from the diagnostic multiple logistic regression. As the cues had used different measurement scales, it was necessary to standardise the cue values to remove the confounding effect of these measurement scales so as to enable meaningful comparisons. Transforming each cue to z-scores does not affect the cue intercorrelations, so the cues values were standardised by calculating z-scores for each cue before the regression models were constructed (Cooksey, 1996a). The relative weights were calculated by dividing the validity coefficient of each cue by the sum of all the regression coefficients and the constant. The treatment relative cue weights were similarly derived from the correlation coefficients (the beta values) from the treatment multiple logistic regression. The same approach was used to obtain the diagnostic and treatment relative cue weights for the ecologies.

Calculation of nomothetic cue weights

Although there was little evidence of significant intercollinearity with either the diagnostic or treatment cues, the logistic regression models for each participant and the ecology were occasionally associated with large standard errors for some cues. Large values of standard error indicate that a statistic from a given sample may not be an accurate reflection of the population from which the sample came (Field, 2005b) which in this case refers to the sample of scenarios, rather than the sample of nurse participants. In previous judgement analysis studies where standard error had been high, it had been suggested that this might have been due to less than optimal sample sizes in following the recommended ratio of five scenarios to one cue (Yang, 2009). However, in this study, there was a much higher ratio of scenarios to cues and the sampling approach meant that the scenario sample was known to closely represent the population from which it was drawn. Therefore, despite the occasionally large standard errors, these factors, alongside the very low level of intercollinearity, suggested that the regression co-efficients could be viewed as adequate predictions of outcomes from which nomothetic cue weights could be calculated.

Initially, an *absolute* approach was used to categorise each nurse participant into one of two groups according to their job role as either a 'generalist' or as a 'specialist' as described earlier in this chapter. However, in addition, a *relative* approach was also used to categorise each nurse in relation to 'level of experience', 'level of education' and 'level of knowledge/expertise' based on the data from the 'expertise' survey undertaken as the first stage of the data collection. Data was categorised as shown in Table 5.14 and a simple scoring system was used to designate the levels of experience, education and knowledge / expertise for each nurse participant.

The aggregated strategy for each group was calculated as the mean of the regression coefficients for each group. In order to make meaningful comparisons with values that would happen by chance alone, the values for skewness and kurtosis were converted to z-scores. With regard to the diagnostic data, the majority of the z-scores were below 1.96 but three z scores were greater than 1.96 but below 2.58. Since the sample was small, these z-scores of skewness and kurtosis did not indicate significant skew or kurtosis (Field, 2005b). Therefore, Student's t-test for independent means was used to

test whether the difference between the two means of each group was significantly different.

Table 5.14 – Scoring system for nurse groupings				
				Points
Experience	Nursing experience	0-2 years or 2-5 years	Less Experience	0
		5-10 years or >10 years	More Experience	1
	Leg Ulcer Experience	< 5year	Less Experience	0
		5 years or more	More Experience	1
Education	General Nursing Qualification	Registered Nurse or Post Reg community nursing qualification	Less Education	0
		Nursing Degree or Post Graduate Degree	More Education	1
	Prescribing Qualification	None or Nurse Prescriber	Less Education	0
		Non-Medical Prescriber	More Education	1
	Leg Ulcer Education	Study days only	Less education	0
		Diploma/Degree/Post Graduate	More Education	1
Knowledge and Expertise	Seniority	Staff Nurse	Less Knowledge / expertise	0
		Sister / Team Leader / Specialist Nurse	More Knowledge / Expertise	1
	Supervision	Always / Usually / Sometimes	Less Knowledge / expertise	0
		Occasionally / Rarely/ Never	More Knowledge / Expertise	1
	Time	Specified time	Less Knowledge / expertise	0
		As long as is needed	More Knowledge / Expertise	1
	Peer Opinion	New / Basic Skills / Some skills	Less Knowledge / expertise	0
		Considerable skills / Advanced / Expert	More Knowledge / Expertise	1
More Experienced = 2 points More Educated = 2 or more points More knowledge / expertise = 3 or more points				

This approach was repeated with the treatment data. Most of the z-scores were below 1.96, but two z scores were greater than 1.96 but below 2.58. Since the sample was small, this did not indicate significant skew or kurtosis (Field, 2005b) and for these cues Student's t-test for independent means was used to test whether the difference between the two means of each group was significantly different. However, the kurtosis z score for infection was above 2.58 for both the 'less education' group and the 'Tissue Viability Specialist Nurse' group. Therefore, for the infection cue, the Mann-Whitney test was used to test whether the difference between the two means was significantly different (Field, 2005b).

Judgement consistency on replication cases

Judgement consistency was examined through comparing the judgements on 20 replicated scenarios contained within the total pool of scenarios (as described on p. 92). The aim was to identify the strength of association between the diagnoses (or the treatment choices) of the replica scenarios and the original scenarios. Since each variable only had two categories and the data was categorical (i.e. "uncomplicated venous leg ulcer or not" (or "high compression or not")) calculating the Phi coefficient offered an appropriate statistical approach (Norman and Streiner, 1999, Field, 2005a).

The Phi coefficient is used with 2 x 2 contingency tables to calculate a chi-square based ratio that represents the chance-independent agreement between the nurses' judgements. As the ecology data had been generated from the consensus diagnoses of a group of expert nurses, it was possible that there may have been inconsistency in these judgements. Therefore, Phi coefficients were calculated for the diagnostic judgement and the treatment judgement for the ecology, as well for the overall nurse participant group. Phi coefficients were also calculated for the specialist nurse group, the generalist nurse group, the 'more education' and the 'less education' group for both the diagnostic judgements and the treatment judgements. The total number of phi coefficients was normally distributed and thus the data met the assumptions of parametric tests (Bland, 2000a). Therefore, Student's t test was used to test for difference between the different groups of participants.

Confidence calibration statistics

The quantitative data regarding confidence was analysed using confidence calibration, which is an analytical technique which considers the relationship between the participant's confidence in their judgement or decision, and their level of judgement accuracy (Lichtenstein and Fischhoff, 1982, Keren 1991). The association between the participants' confidence ratings and their level of judgement correctness can be described by:

- the calibration score
- the level of over / under-confidence, and
- resolution.

Calibration in confidence is the correspondence between subject's own assessment of their confidence in their own judgement (as indicated on the Likert scales within the judgement task) and the empirical probability of that judgement being correct (Petrusic and Baranski, 1997). The calibration score is mathematically calculated as the sum of squared deviations away from a 45^{o} line in a scatter plot, which plots the reported confidence ratings against the associated proportion correct, weighted by the number of responses in each confidence category and divided by the total number of responses (Soll, 1996). The equation is as follows (Petrusic and Baranski, 1997):

$$\frac{1}{n}\sum_{j=1}^{j} nj\ (\bar{pj} - \bar{ej})2$$

Where:

n = the total number of responses

j = the total number of confidence categories

nj= the number of responses in confidence category j

$\bar{pj}$ = the mean confidence level associated with category j

$\bar{ej}$ = the mean proportion correct associated with category j

The calibration score derived from this equation provides a weighted squared deviation between the mean proportion correct and the mean confidence rating associated with each confidence category (Lichtenstein and Fischhoff, 1982). '0' indicates perfect calibration while '1' indicates the worst possible calibration. Therefore, a judge who rated their confidence at 100% when the judgement was wrong would score '1. By contrast, a judge who rated their confidence level at 70% and who achieved a 70% correct judgement rate would score '0' indicating perfect calibration.

Over or under confidence occurs when the subjective confidence score either exceeds or under-estimates the level of the correct judgement rate. This is calculated by computing the difference between the mean confidence levels and the mean proportion of correct diagnoses and treatment judgements. A negative score indicates under-confidence while a positive score indicates over-confidence.

Resolution is the measurement of an individual's ability to use their confidence ratings to discriminate between correct and incorrect judgements. The calculation of resolution requires the confidence ratings to be categorised into bandings (such as 0-0.9%,10% - 19% etc) which are then used to calculate a weighted squared deviation between the mean proportion that are correct for each confidence category and the overall proportion of correct responses at the whole group level. The equation is as follows (Petrusic and Baranski, 1997):

$$\frac{1}{n}\sum_{j=1}^{j} nj\ (\bar{e}j - \bar{e})2$$

Where:

n = the total number of responses

j = the total number of confidence categories

nj= the number of responses in confidence category j

$\bar{e}j$ = the mean confidence level associated with category e

$\bar{e}$ = the mean proportion correct associated with category e

The resolution score is therefore conditional upon the mean proportion of correct answers which prevents a meaningful comparison of the discrimination skills of two different individuals. This problem can be overcome by calculating a normalised resolution score which adjusts for the knowledge index using the following equation:

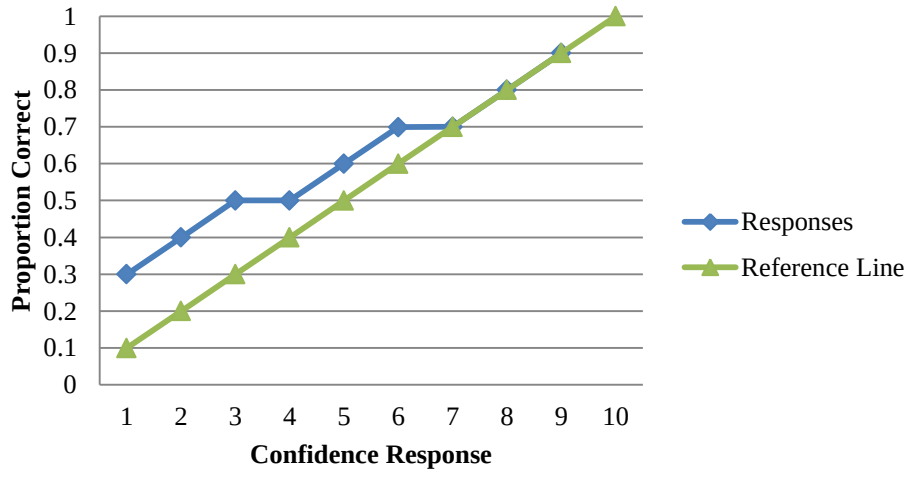
$$\left[\frac{1}{n}\sum_{j=1}^{j} n_j \, (\bar{e}_j - e)2\right] / \bar{e}\,(1-\bar{e})$$

Normalised resolution scores range from 0 to 1 with a higher score indicating a higher ability to differentiate between correct and incorrect answers. Therefore, normalised resolution scores enable an individual's judgement achievement to be further unpacked. For example, if a nurse had high confidence scores on incorrect judgements but low confidence scores on correct judgements they would have a poor calibration score (indicating their poor assessment of their own accuracy) but a high resolution score (indicating their good ability to discriminate between correct and incorrect answers).

Calibration Curve Analysis

Another way to examine the relationship between probability judgements and confidence ratings is through the construction of calibration curves. A calibration curve (Figure 5.5) is constructed by plotting the proportion of correct answers on the y axis against the confidence ratings (converted into ordinal categories as described above) on the x axis (Soll, 1996). A 45^0 line indicates perfection calibration. Any deviations

Figure 5.5 Example of a Confidence Calibration Curve



away from the line indicate miscalibration (indicating over-confidence and under-confidence). The lower the curve is below the perfect (45^{o} degree) line, the greater the tendency towards over-confidence and vice-versa. So in the example above, the informant is under-confident at lower levels of accuracy, but perfectly calibrated at higher levels of accuracy.

Idiographic confidence calibration analyses and calibration curve analyses were undertaken and the data was assessed against the assumptions of parametric testing (i.e. normal distribution, skewness and kurtosis). The confidence calibration data met these assumptions and therefore Student's t-test was used to test for differences between groups. There was evidence of positive skewness and kurtosis for the resolution data so the values were converted to z-scores before Student's t-test was used to test for differences between groups.

5.4. Design 2 –Think Aloud techniques

Think Aloud techniques were used alongside the judgement task to generate data about cognition to answer the research question:

- What cognitive processes do community nurses use when making clinical judgements and decisions about venous leg ulceration?

As discussed in Chapter 3, although Think Aloud' (TA) methodology would potentially increase the validity of the overall results, Think Aloud methods are vulnerable to Hawthorn effects which can threaten validity of the Think Aloud data. Therefore, careful implementation was required in order to minimise such threats to validity.

5.4.1. Sampling

This thesis was interested in the cognitive processing of community nurses while making judgements about the diagnosis and treatment of patients with leg ulcers. Therefore, a small sample of nurse informants who were capable of providing information about their cognitive processing during clinical judgement for leg ulceration

was required. Theoretical sampling offered an approach to obtaining such a sample (Silverman, 2000). Theoretical sampling is a systematic sampling approach that employs theoretical considerations to select cases in terms of their relevance to the research question and emerging theoretical position. Such samples are usually small, since the aim is rich, in-depth data rather than statistical generalisability.

Although all the nurse judges fell within 'Cell A' type, there was still some variation in terms of level of expertise. As with the data collection for the Judgement Analysis, a *relative* approach was used to segregate 'more expert' nurses from 'less expert' nurses through their role in relation to leg ulcer care, in order to sample similar numbers of informants in each group. The sampling frame comprised of all the consenting nurse judges: the first three generalist nurse judges were selected to contribute data to the 'think-aloud' data collection. Similarly the first four nurse specialists who formed the expert consensus group were selected to contribute data.

5.4.2. *Data collection*

The judgement scenarios provided highly appropriate simulations of judgement situations. For the TA data collection the informants were joined by the researcher for the first 30 minutes of their data input. Data collection was undertaken in a quiet setting with internet access. The researcher was already known to the participants as an ex-tissue viability specialist nurse. To minimise impact on the data, the researcher sat behind and away from the nurse participants but sufficiently close to record the time at which each new judgement scenario was accessed, in order to be able to relate the data collected on the audiotape to individual judgement scenarios. Field notes of the nurses' non-verbal behaviour during the process were kept.

For the generalist nurses, data was gathered on an individual basis. The nurse was asked to log onto the survey tool and to start making the judgements as prompted by the online survey tool. The nurse was asked to think-aloud as they made their judgements and was explicitly instructed to focus on the task and only verbalise their thoughts (rather than explain their thinking). The nurse was reminded to 'keep thinking aloud' if they were silent for more than a few seconds but otherwise all interaction was kept to a

minimum (Fonteyn et al., 1993). The first 30 minutes of the session was audio-taped. Following this data collection, the nurse was left to complete the remainder of the Judgement Analysis task under the same conditions as the other participants.

For the specialist nurses, data was gathered from their discussions when they met as an expert panel to provide the consensus judgements and decisions for the ecology side of the Lens Model. Again, the nurses were asked to log onto the survey tool, but this time as a group, and to start making the judgements as prompted by the online survey tool. A purist TA method involves collecting individual cognition data from solo participants and so the TA method used in this study did not follow a purist TA method but instead involved a group-based Think Aloud technique: i.e. the nurses needed to communicate their thoughts to each other in order to arrive at a group consensus. Community nurses usually work within a team and discuss their clinical judgements with colleagues, thus this group-based approach offered a more ecologically (or externally) valid or trustworthy means of accessing community nurses' clinical cognition. Again, all interaction between the nurses and the researcher were kept to a minimum and the first 30 minutes of the session was audiotaped.

Retrospective reporting techniques were not used as the resources that would have been required for the size of the survey and geographical spread of the participants were prohibitive. Furthermore, while it has been suggested that a silent control group that reports retrospectively should be added to any 'think-aloud' research design to enable accuracy to be compared (Russo et al., 1989) there is evidence to suggest that the addition of a silent control group is unnecessary (Ericsson and Simon, 1998).

5.4.3. Data analysis

The audiotapes were transcribed and then these transcripts ('protocols') were divided into syntactic segments. Those portions that did not reflect cognition (such as when the nurse was reading the patient scenario) were identified and labelled and 'fillers' such as 'ah' and 'erm' were removed from the protocols. The protocols were analysed using Fonteyn et al's (1993) three step process and using a hypothetico-deductive approach which applied a pre-established coding system to the data (Fonteyn et al., 1993).

1. Referring phase analysis (RPA)

This stage sought to identify the information that the nurses concentrated upon. Initially, all noun and noun phrases were underlined and coded with the name of the concept of reference to indicate the concepts upon which the participant focussed. The definitions of the coded concepts are shown in Table 5.15.

Table 5.15 Referring phrase analysis

Coded Concept	**Definition**
Action	The manner or method of performing; a thing done
Patient	An individual with health problems
Sign(s)	Objective clinical information indicative of status
Time	A chronological reference
Treatment	Therapeutic substances or procedures
Value	A rating or scaling of usefulness, importance or worth

(Fonteyn et al., 1993)

The initial coding was provisional, as another researcher familiar with leg ulceration was asked to undertake the same process with randomly selected portions of the protocols to determine whether there was sufficient similarity in coding decisions between our coding. Table 5.16 gives an example of how referring phrase coding was applied to the data.

Table 5.16 Example of referring phrases and coded concepts (Generalist Nurse 1 – Scenario 1)	
Data	**Coded Concept**
The *lady* is *seventy seven years old,* she's got quite a *complex history of conditions*	*Patient, Time, Signs* *Signs*
I'd be a bit worried about her *medication* affecting, sort of potentials for leg ulcers,	*Sign*
she's had *leg ulcers before*, she's got an *API of 0.85* so she's okay for compression,	*Sign, Sign, Value* *Treatment*
high pain score, leg ulcer is thought to be *infected,* need to get the *infection cleared up* really. Probably *do a swab see if she needs some antibiotics,*	*Sign* *Treatment* *Treatment*
I want to know a bit more about this *lady's mobility* really, and her *pain*. Is it *worse* when your leg is up /down?	*Patient, sign,* *Value*
So I think looks like it is a *venous leg ulcer*, I'm fairly confident that's what it is, maybe a bit of *arterial involvement* there but okay with *mainly venous*.	*Action (diagnosis)*
I'm going to go for the *elastic two layer compression bandaging.* Yeah I'm fairly confident that that's what I want to put on.	*Action, Treatment*

2. Assertional analysis (AA)

The set of assertions made by the nurses was then identified to establish how the nurses made relationships between different concepts during their decision making. For example, assertions about connotations form relationships of meaning, indicative assertions form relationships of significance and causal assertions form relationships of cause and effect as shown in Table 5.17 (Fonteyn et al., 1993).

Table 5.17 Assertional analysis	
Assertion	**Definition**
Connotative	Forming relationships of meaning
Indicative	Forming relationships of significance
Causal	Forming relationships of cause and effect

(Fonteyn et al., 1993)

The purpose of these assertions along with the concepts identified during the referring phase analysis constituted the knowledge basis for the nurses' cognition. Table 5.18 gives an example of how assertional analysis was applied to the data.

Table 5.18 Example of assertional analysis (Generalist Nurse 1 – Scenario 1)	
Data	**Assertion**
The *lady* is *seventy seven years old,* she's got quite a *complex history of conditions*	
I'd be a bit worried about her *medication* affecting, sort of potentials for leg ulcers,	Indicative
she's had *leg ulcers before*, she's got an *API of 0.85* so she's okay for compression,	Connotative Indicative
high pain score, leg ulcer is thought to be *infected,* need to get the *infection cleared up* really. Probably *do a swab see if she needs some antibiotics,*	Connotative Indicative
I want to know a bit more about this *lady's mobility* really, and her *pain*. Is it *worse* when your leg is up /down?	Causal
So I think looks like it is a *venous leg ulcer*, I'm fairly confident that's what it is, maybe a bit of *arterial involvement* there but okay with *mainly venous*.	Causal
I'm going to go for the *elastic two layer compression bandaging.* Yeah I'm fairly confident that that's what I want to put on.	Causal

3. Script analysis

In this stage inferences were made about the reasoning processes that the nurses used to make diagnoses and treatment judgements. Script analysis illustrated the information that the nurse attended to, how the nurse structured the problem, the nurse's rationale for the diagnoses and treatment choices they made and their eventual diagnoses and treatment choices. The protocols were analysed to provide an overall description of the nurse's reasoning processes during decision making. A set of cognitive-operators were adopted from a previous study (Fonteyn et al., 1993) as shown in Table 5.19. These were applied to the data in order to organise the data and make the reasoning process more comprehensible.

Table 5.19 Script Analysis

Operator	**Definition**
Study	To consider information carefully
Choose	To decide on action to take
Explain	To provide rationale for an action
Conclude	To decide on the significance, value or meaning of information

(Fonteyn et al., 1993)

Table 5.20 gives an example of how script analysis was applied to the data.

Table 5.20 Example of script analysis (Generalist Nurse 1 – Scenario 1)	
Data	**Operator**
The lady is seventy seven years old, she's got quite a complex history of conditions	Study
I'd be a bit worried about her medication affecting, sort of potentials for leg ulcers,	Explain
she's had leg ulcers before, she's got an API of 0.85 so she's okay for compression,	Study Conclude
high pain score, leg ulcer is thought to be infected, need to get the infection cleared up really. Probably do a swab see if she needs some antibiotics,	Study Explain Choose
I want to know a bit more about this lady's mobility really, and her pain. Is it worse when your leg is up /down?	Study
So I think looks like it is a venous leg ulcer, I'm fairly confident that's what it is, maybe a bit of arterial involvement there but okay with mainly venous.	Choose
I'm going to go for the elastic two layer compression bandaging. Yeah I'm fairly confident that that's what I want to put on.	Choose

Since the main aim of the TA technique in this study was to generate data about the cognitive processes of the nurses, this approach principally sought to identify any patterns of predominant reasoning processes that resembled processes described in the judgement or decision theory literature as outlined in Chapter 3. However, the analysis also sought to explore what subjects the nurses attended to during the judgement and decision making process and what rationale, if any, they provided for their decisions (Fonteyn et al., 1993).

5.5. Conclusion

This chapter has outlined the research methods that underpin this thesis. It has described how for Design One, the Judgement Analysis task was constructed to maximise representativeness through using actual patient records. It has described a sample size calculation for the required number of judgement profiles which decreased the risk of unstable regression estimates while decreasing the risk of overloading to the nurse informants. A defensible rationale has been presented to justify the sampling procedures for the judgement profiles and nurses, the methods for data collection for both the ecology data and the data from the nurses and the methods of data treatment and statistical analysis. Finally, a detailed explanation of the methods used for the sampling approaches, data collection and analysis methods of the Design Two Think Aloud, have been described. The next chapter will present the results.

CHAPTER 6

RESULTS: PART 1

DEMOGRAPHIC CHARACTERISTICS AND DESCRIPTION OF THE CUE INFORMATION

The next three chapters present the results. This chapter describes the nurses' demographic characteristics and how the information related to diagnosis and treatment was distributed within the patient scenarios. Chapter 7 will evaluate the results regarding diagnosis. How did the nurses use the diagnostic information? How closely did their diagnoses agree with the diagnoses of the ecology lens model? What cognitive processes were apparent as they made these diagnoses? Chapter 8 will evaluate the results regarding treatment. How did the nurses use the treatment information? How closely did their treatment choices agree with the treatment choices of the ecology lens model? What cognitive processes were apparent as they made these treatment choices?

6.1. Nurse participants

Despite extending the recruitment period and increasing the number of recruitment sites, recruitment did not achieve the desired number of participants (38 participants). However, 36 participants were recruited which was sufficiently close to the target so as not to invalidate the results.

In total, 36 registered community nurses took part in the Judgement Analysis (Table 6.1). Half were District Nurses or Practice Nurses (generalist community nurses (GCNs)) and half were community tissue viability specialist nurses (TVSNs). All were female and the average age in both groups was similar (GCNs = 48 years and TVSNs = 45 years) although there was a wider spread of ages in the TVSN group (GCNs SD = 4.13 and TVSNs SD = 10.34). A large proportion of the nurses in both groups had over 10 years nursing experience (GCNs = 83.3%, TVSNs = 72.2%). The number of years of leg ulcer experience was also very similar in both groups (GCNs = 12 years, TVSNs = 13 years). The TVSNs on average worked slightly more hours per week (hpw) (GCNs = 30 hpw, TVSNs = 35) but they spent more than double the time of the GCNs on leg ulcer care (GCNs = 7 hpw, TVSNs = 15 hrspw).

Table 6.1 Demographic characteristics										
		Types of Nurses							
Demographic Categories		Generalist Community Nurses (GCNs)				Tissue Viability Specialist Nurses (TVSNs)			
		n	%	Mean	SD	n	%	Mean	SD
Gender	Female	18	100			18	100		
	Male	0	0			0	0		
Area of Practice	General practice	9	50			0	0		
	District Nursing	9	50			0	0		
	Tissue Viability Specialist	0	0			18	100		
Mean Age (in years)				48	4.13			45	10.34
Nursing Experience	0-2 years	1	6			0	0		
	2-5 years	0	0			1	6		
	5-10 years	2	10			4	22		
	>10 years	15	84			13	72		
Mean Leg Ulcer Experience (in years)				12	5.27			13	6.56
Mean Hours Per Week Nursing				30	7.90			35	4.56
Mean Hours Per Week on Leg Ulcer Care				7	6.26			15	6.92
Nursing Qualifications	Nursing degree	2	11			8	44		
	Post graduate qualification	4	22			8	44		
Prescribing Qualifications	Nurse Prescriber	5	28			6	33		
	Non-medical Prescriber	2	11			7	39		
Leg Ulcer Education	Study Days	12	67			6	33		
	Diploma level	5	28			5	28		
	Degree level	1	6			6	33		
	Master's level	0	0			1	6		
Job Title	Staff Nurse	2	11			0	0		
	Sister/ Team leader	16	90			0	0		
	Specialist Nurse	0	0			18	100		
Level of Supervision	Usually	2	11			2	11		
	Sometimes	3	17			1	6		
	Occasionally	6	33			3	17		
	Rarely / Never	7	39			12	67		
Allocated Time per Leg Ulcer Treatment	10 minutes	1	6			0	0		
	20 minutes	1	6			0	0		
	30 minutes	4	22			1	6		
	40 minutes	2	11			2	11		
	As long as is needed	10	56			15	83		
Level of Perceived Expertise	Some skills	3	17			1	6		
	Considerable skills	11	61			2	11		
	Advanced skills	3	17			8	44		
	Expert	1	6			7	39		

Academic attainment varied between the two groups. Only 11% of the GCNs were educated to degree level although 22% had post graduate qualifications. (This result seems surprising but in nursing, it is sometimes possible to undertake post-graduate level qualifications without holding a first degree). In contrast, 44% of TVSNs were educated to degree level and the same proportion also had post graduate qualifications. Similarly, a higher proportion of TVSNs held the Nurse Prescribing qualification compared to the GCNs (TVSN = 33%, GCNs = 28%). An even higher proportion of TVSNs held the more advanced Non-Medical Prescribing qualification (TVSNs = 40%, GCNs = 11%,). With regard to education that focussed on leg ulcer care, a larger proportion of GCNs had attended study days (TVNS = 33%, GCNs = 67%). The same number of GCNs and TVSNs had undertaken diploma-level leg ulcer related study (28%). However, considerably more TVSNs had undertaken degree and post-graduate level study relating to leg ulceration (TVSNs = 33%, GCNs = 6%). Therefore, overall, there was a higher level of academic attainment in the TVSN group compared to the GCN group.

There was little variation between the two groups in relation to perceptions relating to expertise. Job title (which might indicate seniority) showed little variation between the two groups since the majority of nurses who took part were either specialist nurses or senior generalist nurses. There were only two staff nurse participants and both of these were GCNs. There was also similarity in the level of supervision reported between the GCNs and the TVSNs. 68% of TVSNs and 39% of GCNs reported that they were 'rarely/never' supervised and 17% of TVSNs and 33% of GCNs reported being only occasionally supervised. These levels of supervision suggest a high level of professional autonomy and if these figures are aggregated for each group (GCNs = 72%, TVSNs = 84%) the difference is relatively small. Similarly, if time allocated per treatment is viewed as an indicator of autonomy over clinical time, then a similar proportion of both TVSN group and the GCN group (100% and 89% respectively) allocated 30 minutes or over. Finally, the nurses were asked how others perceived their knowledge and skills regarding leg ulceration. Unsurprisingly in view of their role, the TVSN group indicated that they thought that others perceived them as having a high level of expertise with 44% reporting that they were viewed as having advanced skills and 39% as being viewed as an expert. However, 61% of the GCN group reported that they were viewed

as having ‘considerable’ skills, 17% as having advanced skills and 6% as being an expert. Therefore, although the TVSN group might be perceived as being more expert than the GCN group, the GCN group were thought to be perceived by others as having a high level of knowledge and skills for leg ulcer care.

One of the aims of this thesis was to consider the impact of expertise on the judgement and decision making of community nurses. As discussed in Chapter 5, when sampling the nurses, expertise had been approached from a *relative* approach through recruiting through job role with the tissue viability specialist nurses (TVSN) forming a ‘more expert’ nurse group and the generalist community nurses (GCN) forming a ‘less expert’ nurse group. I recruited sufficient participants in each group, so it was possible to test for significant differences between these two groups and these results will be reported in the next two chapters.

The plan had been to examine the impact of the attributes thought to contribute to expertise such as ‘experience’, ‘education’ and ‘peer opinion of expertise’ (see Chapter 3) using the demographic data described above. However, as there were minimal differences between the participants in relation to ‘experience’ and ‘peer opinion of expertise’, it was not possible to carry out statistical comparisons in relation to these variables. It was possible to compare the impact of education as the total group was evenly divided into those categorised as having ‘more education’ and those with ‘less education’. These analyses will also be described in the next two chapters.

6.2. Distribution of the information within the scenarios

Representative design is a key tenet of Judgement Analysis design (see Chapter 4) so it was important to assess whether the distribution of the information (cues) within the scenarios sufficiently represented the natural clinical environment in which nurses make such judgements (*task congruence).* Tables 6.2 and 6.3 summarise how the information cues that related to diagnosis were distributed within the patient scenarios. Table 6.2 shows the distribution of the cues that were measured using continuous data. Table 6.3 shows the distribution of cues that were measured using categorical data.

Table 6.2 Distribution of information cues for diagnosis - continuous cues				
Cue	**Mean**	**(sd)**	**Minimum**	**Maximum**
Age	76	9.83	34	96
Pain	4.03	2.97	0	10

Table 6.3 Distribution of categorical diagnostic cues			
Cue	**Sub -cue**	**Frequency**	**%**
Medical history	Venous disease	56	51
	Arterial disease	9	8
	Venous and arterial disease	32	29
	Neither venous or arterial disease	13	12
Appearance of limb	Signs of venous disease	72	66
	Signs of arterial disease	3	3
	Signs of other disease	3	3
	No signs of disease	23	21
	Signs of venous and arterial disease	8	7
	Signs of venous and other disease	1	1
ABPI	Below 0.8 or above 1.2	50	46
	Above 0.8 and below 1.2	60	54

The age of the patient participants ranged from 34 years to 96 years old but the average age was 76 years. Since leg ulceration is known to be more common in older people (see Chapter 2) this suggested that the sample was representative in terms of age. Pain scores ranged from 0 (no pain) to 10 (worst possible pain) but the mean score was 4.03 on the scale of 0-10. This reflected the findings of a study into leg ulcers (Closs et al., 2008) which suggests that the sample was representative in terms of pain.

Half the patient participants (51%) had a medical history of venous disease but nearly 30% had a history of both venous and arterial disease. Only 12% had no history of either venous or arterial disease. In relation to the 'appearance of the limb' (apart from the ulcer) 66% of patient participants had signs of venous disease but only 3% had visible signs of arterial disease or another disease. 21% had no visible signs of disease

on their limb. 54% of the patient participants had an ABPI of above 0.8 and below 1.2 which the leg ulcer literature regards as indicating adequate arterial supply (see Chapter 2). However, 46% of patients had an ABPI of below 0.8 or above 1.2 which is thought to indicate possibly significant arterial disease. No reliable data was found within the current literature leg ulcer literature against which to compare these data from this study.

Table 6.2 and Table 6.4 summarise how the information cues relating to treatment were distributed within the patient scenarios. The only treatment cue that was measured using continuous data was pain: this cue also provided information for diagnosis and thus its distribution is shown in Table 6.2 above. Table 6.4 shows the distribution of the information cues for treatment which were measured using categorical data.

Table 6.4 Distribution of categorical treatment cue variables

Cue	Sub -cue	Frequency	%
Diagnosis	Not uncomplicated venous leg ulceration	53	48
	Uncomplicated venous leg ulceration	57	52
Exudate levels	Minimal	28	26
	Moderate	51	46
	Heavy	31	28
Infection	Infected	18	16
	Not infected	92	84
Gender	Male	54	49
	Female	56	51
Patient Preferences	Prefers no compression	12	11
	Accepts compression	98	89

The information for the diagnosis cue was taken from the diagnosis judgement that the nurse had made as the first part of the Judgement Analysis task. The sampling strategy for the scenarios had been stratified according to the UK reported diagnoses proportions (see Chapter 5). Originally 59% of the sample had had a diagnosis of uncomplicated venous leg ulceration but the expert consensus panel had diagnosed only 57% of the diagnoses as uncomplicated venous leg ulceration. However, as the distribution of these

diagnoses was only slightly different from the original diagnoses the sample remained sufficiently representative.

The sample was evenly distributed in terms of gender comprising of 49% men and 51% women which was a slightly higher proportion of men compared to other leg ulcer studies (Iglesias et al., 2004, Closs et al., 2008, Watson et al., 2011). A large proportion (74%) of the sample had 'wet' ulcers with moderate or heavy exudate but no reliable data was found within the current leg ulcer literature against which to compare this data. 11% of the total sample had expressed a preference against having compression. (It should be noted that this was a preference, not a refusal) This percentage included the patients from the Venus II population whose 'preference' had been artificially determined (see Chapter 5) alongside the NHS patient cohort who had expressed their preference. This was a slightly lower proportion of patients compared to a previous study (Nelson et al., 2004) but was sufficiently similar to be judged as representative. Therefore, so far as it was possible to establish, the distribution of the information within the scenarios sufficiently represented the natural clinical environment in which nurses make such judgements.

This chapter has described the nurse participants' demographic characteristics and the distribution of the information upon which their judgements and decisions were based. The next chapter will evaluate how these nurses used the information in the scenarios to make their diagnostic judgements.

CHAPTER 7

RESULTS: DIAGNOSIS OF VENOUS LEG ULCERATION

This chapter evaluates the results for diagnosis of leg ulceration. It describes how the nurses used the diagnostic information in the patient scenarios and evaluates how closely those diagnoses agreed with the diagnoses of the ecology lens model. Comparisons are made between the specialist nurses and the generalist nurses to establish whether there are any differences in how the available information was used and whether either group was more accurate in their diagnostic judgements. These comparisons are also made between nurses with higher levels of education and those with lower levels of education. Judgement consistency on replicated scenarios is assessed and the nurses' confidence in their diagnostic judgements in relation to their levels of 'accuracy' is evaluated. Finally, the cognitive approaches apparent during diagnosis are described.

7.1. The predictability of the Lens Model for diagnosis

As discussed in Chapter 2, clinical judgement and decision making is inherently uncertain. The predictability parameter of a Lens Model incorporates consideration of that uncertainty through representing the degree to which the model will vary in how well it predicts the ecological criterion (as described in Chapter 4). The predictability of a judgement task (Re) is measured by correlating the ecology criterion value (e.g. whether the ulcer is or is not an uncomplicated venous ulcer) against the ecology predicted criterion value (e.g. whether the model predicts whether the ulcer is or is not an uncomplicated venous ulcer). A model which predicts perfectly would achieve a correlation of 1.00 (R_e = 1). The predictability of the Lens Model for diagnosis (R_e= 0.63) indicates that it is an imperfect predictive model.

7.2. The use of the diagnostic information

7.2.1. Cue weightings

The cue weights indicate the importance of each cue in the diagnostic judgement as described in Chapter 5. In this thesis, relative cue weights were calculated to compare the contribution of each cue to the diagnostic judgement. The relative weight of each of the cues is equivalent to there being 100 points to divide up between the cues, according to the significance of each cue in the diagnostic judgements. The ecology diagnostic cue relative weights are shown in Table 7.1 in rank order alongside the diagnostic cue relative weights for the 36 nurse participants.

Table 7.1 Relative weights for cues for diagnosis
Ecology vs. Nurse participants

Cue	Ecology		Nurse Participants (n= 36)		
	Rank	**Weight**	**Rank**	**Mean Weight**	**SD**
ABPI	1	53	1	52	16.67
Medical History	2	28	2	14	9.02
Appearance	3	15	5	9	6.15
Pain	4	2	4	12	9.00
Age	5	2	3	13	10.31

Table 7.1 shows that for both the ecology and the nurse participants the most important cue in the diagnostic judgement was 'ABPI' and a similar level of importance was allocated to this cue in the ecology and by the nurse participants. The second highest ranking cue for both the ecology and the nurse participants was 'medical history' but Table 7.1 shows that the ecology gave this cue almost double the weight compared to that allocated by the nurse participants: in other words, the nurse participants greatly underused this cue. In the ecology, the third highest weighting was allocated to 'appearance' but this was the lowest ranking cue for the nurse participants so again, the nurse participants underused this cue. 'Pain' and 'age' were allocated very low weights in the ecology but the nurse participants allocated considerably more weight to these

cues giving them very similar levels of weight to 'medical history' and placing more reliance on these cues than the ecology indicates is appropriate. Each of the cues had large standard deviations in relation to the mean.

One of the aims of this thesis was to consider the impact of expertise on the judgement and decision making of community nurses. As discussed in Chapter 5, when sampling the nurse participants, expertise had been considered from a *relative* approach through recruiting through job role. The tissue viability specialist nurses (TVSN) formed the 'more expert' nurse group while the generalist community nurses (GCN) formed the 'less expert' nurse group. Both groups contained the same number of nurses and the initial nomothetic comparison was between these two groups of nurses. Table 7.2 shows the diagnostic cue relative weights for nurse role compared to the ecology cue relative weights. None of the differences were statistically significant.

Table 7.2 Relative weights for cues for diagnosis
Tissue viability specialist nurses vs. Generalist community nurses

Cue	Ecology		TVSN (n= 18)			GCN (n= 18)				
	Rank	Weight	Rank	Mean Weight	SD	Rank	Mean Weight	SD	t(df 34)	Sig (2-tailed)
ABPI	1	53	1	54	12.21	1	50	20.32	-1.36	0.18
Medical History	2	28	2	14	9.96	2	14	8.27	-0.55	0.59
Appearance	3	15	5	10	6.57	5	8	5.78	-0.97	0.34
Pain	4	2	3	11	6.26	2	14	8.78	0.73	0.47
Age	5	2	3	11	7.12	2	14	12.79	0.55	0.58

As described in Chapter 6, although demographic data had been collected with the aim of examining the impact of the attributes thought to contribute to expertise, the similarity between the participants for almost all the attributes meant that statistical analyses could only be carried out into the impact of education. Table 7.3 shows the diagnostic cue relative weights for the 'more education' and 'less education' groups alongside the ecology cue relative weights but again, none of the differences were statistically significant.

Table 7.3 Relative weights for cues for diagnosis

More education vs. Less education

Cue	Ecology		More Education (n= 18)			Less Education (n= 18)				
	Rank	Weight	Rank	Mean Weight	SD	Rank	Mean Weight	SD	t(df 34)	Sig (2-tailed)
ABPI	1	53	1	54	12.21	1	50	20.32	-0.61	0.55
Medical History	2	28	2	14	9.96	2	14	8.27	-0.14	0.89
Appearance	3	15	3	10	6.57	5	8	5.78	-1.84	0.08
Pain	4	2	3	11	6.26	4	14	8.78	01.14	0.26
Age	5	2	3	11	7.12	2	14	12.79	0.51	0.51

Conclusions for the cue weightings for diagnosis

ABPI was the most important cue for the diagnosis of venous leg ulceration and the nurses gave this cue a similar weighting, to that given in the ecology indicating that this cue was appropriately used. Medical history was the second most important cue in the ecology and although it was less important than the ABPI cue it still carried considerable weight. However, the nurses gave similar levels of importance to all the cues, except the ABPI cue, thus over-using 'age' and pain; and under-using 'medical history' and 'appearance' No differences were detected between the cue weightings of the TVSNs and the GCNs or between nurses with different levels of education.

7.2.2. Identification of diagnostic cues

The Think Aloud (TA) process collected diagnosis and treatment judgements for 59 patient scenarios which were transcribed from audio recordings into written transcripts. Of these, 50 were patient scenarios which were considered by the generalist nurses while the remaining 9 scenarios were those considered by the expert group (Table 7.4).

Table 7.4 Patient scenarios considered for think aloud

Participants	No of Judgements	No of Treatment Decisions
Generalist Nurse 1	15	15
Generalist Nurse 2	16	16
Generalist Nurse 3	19	19
Expert Group	9	9

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Protocol analysis of the TA data provides an alternative insight into the issues the nurse judges attended to during the diagnostic judgement making process. It was evident from the TA data that the nurse participants used all the cues that had been identified as necessary to inform the judgement task but the TA data identified some additional cues that had not been presented in the Judgement Task.

The GCNs wanted more detailed information about the patients' pain, in particular whether leg elevation affected pain levels and what behaviour or intervention affected pain levels, both for better and worse. The TVSNs in the expert group sought much more detailed information about the process of carrying out the assessment of the ABPI. They wished to know who had carried out the assessment of ABPI, how long had the patient rested before the procedure was carried out, how the patient had been positioned ("Were the legs 'elevated'?") and whether the arteries had been fully occluded. In particular, they sought more information about the pulse sounds (Were the pulses "bounding", "tri-phasic" and regular?). They also wished to know whether unsuccessful assessments of ABPI were due to the patient being unable to tolerate the procedure or the clinician being unable to occlude the arteries. They would have liked to know whether the reading could have been "improved" in any way (such as through different positioning).

Besides more detailed information about the ABPI, the TVNs were also interested in whether visible rubor was "dependent" on position. They also sought more detailed information about patients' pain and the presence of neuropathy. Finally, with regard to the colour of the wound bed they would have liked more information about the dressing

that had been removed. For example, one nurse noted that the black in a wound bed might have been due to a silver dressing.

The exit page of the judgement task offered the participants the opportunity to make comments. Some participants had offered information about the additional cues they would seek to use in their clinical practice. The comments broadly followed the information obtained from the TA analysis. In particular, the tissue viability specialist nurse comments mirrored the data from the expert group, particularly in their wish to have more detailed information about the ABPI reading and about pain. One GCN would have liked more information about odour and one TVSN noted that touch was important in assessment for assessing both oedema and the temperature of the limb. Another TVSN sought more information about appearance and size of the whole affected limb.

Overall, both the GCNs and TVSNs used the cues that were provided within the patient scenarios but reported that they would seek additional more-highly detailed information to support their diagnostic judgement, particularly about pain and the ABPI. In particular, the TVSNs reported that they would seek highly detailed information about how the ABPI assessment had been conducted in order to assess the reliability of the result.

7.3. Accuracy and diagnosis

As described in Chapter 4, in Judgement Analysis the 'accuracy' of a judgement is assessed by how well it fits events in the environment which is being scrutinised (Cooksey 1996). In this thesis, 'accuracy' is assessed by how closely the diagnoses of each nurse correlate with the consensus diagnoses of the expert group (the ecology model). Perfect 'achievement' ($R_a = 1$) indicates that there is a perfect correlation (or match). Therefore, a nurse's level of 'accuracy' is indicated by their level of achievement (R_a). Achievement (R_a) is a function of knowledge (G), predictability (R_e), cognitive control (R_s) and unmodelled knowledge (C). The knowledge parameter (G) represents the extent to which a nurse's use of the information cues provided in the scenario to arrive at their diagnoses correlates to the expert group's use of these cues to arrive at the ecology diagnoses. The cognitive control parameter (R_s) indicates how

much the nurse varies in the level of importance they assign to the same information cue across the judgement task. (Cognitive control' is different to 'consistency' which refers to similarity between judgements on the same judgement profile, rather than similarity across the judgement task. 'Consistency' is considered later in this chapter.) Finally, since not all the aspects of the ecology and judgment processes can be captured in a linear model, there will be some elements which fall outside these judgement models which are represented by the 'unmodelled knowledge' parameters C_1, C_2 and C_3)

7.3.1. Diagnosis Lens Model analysis

Idiographic diagnosis Lens Model analysis

Initially, the mean lens model statistics were calculated from the individual nurse judges' lens model statistics as shown in Table 7.5. The strength of a correlation was considered against Cohen's definitions which define a small correlation as approximately 0.1, a medium correlation as 0.3 and a large correlation as 0.5 or above (Cohen, 1988). There was a medium to large positive correlation for achievement (R_a (36) = 0.48) and a large correlation for cognitive control (R_s (36) = 0.58) which related to the level of consistency in assigning a similar amount of 'weight' to a cue. However, there was only a small to medium positive correlation for knowledge (G (36) = 0.23) which relates to the nurse participants' ability to use the information that the evidence base indicates are relevant. The correlation for the use of unmodelled knowledge by the expert group and that of the nurse participants was also small (C_1 (36) = 0.16, C_2 (36) = 0.00, C_3 (36) = 0.00).

Table 7.5 Aggregated diagnosis lens model statistics for all nurse participants

Lens Statistics		Mean	SD	N
Ra	Achievement/ Accuracy	0.48	0.17	36
Rs	Cognitive Control	0.58	0.13	36
G	Knowledge	0.23	0.11	36
C_1	Unmodelled Knowledge	0.16	0.93	36
C_2	Unmodelled Knowledge	0.00	0.01	36
C_3	Unmodelled Knowledge	0.00	0.01	36

Nomothetic comparisons of diagnosis Lens Model analysis

As with the planned nomothetic group comparisons for the cue weights, it was only possible to carry out comparisons for nurse role and education. The initial nomothetic comparison was between the TVSN group and the GCN group (Table 7.5). There was a large positive correlation between the diagnoses of the TVSNs and the ecology diagnoses (R_a (18) = 0.57) but only a medium positive correlation between the diagnoses of the GCNs and the ecology diagnoses (R_a (18) = 0.38). This difference was statistically significant (t (34) = -3.89, p=<0.01) so unlikely to be due to chance. Therefore, the TVSNs were more accurate in diagnosing uncomplicated venous leg ulceration than the GCNs.

Table 7.6 shows that there was a medium positive correlation between the TVSNs' use of the relevant information cues and the ecology cue use (G (18) = 0.34) but only a small to medium positive correlation between the GCNs' cue use and the ecology cue use (G (18) = 0.25). This difference was statistically significant (t (34) = -2.61, p = 0.01) and suggests that the TVSNs have a higher level of ability or 'knowledge' in managing the information that the evidence base suggests is relevant. Table 7.6 also shows a small to medium positive correlation between the TVSNs' use of unmodelled knowledge (the use of information cues that have not been identified and measured in the model) (C_1 (18) = 0.23) and that of the ecology. This compared to a small positive correlation between the GCNs' use of unmodelled knowledge and the ecology (C_1 (18) = 0.12). The difference was statistically significant. (t (34) = -4.11, p =< 0.01).

Table 7.6 Diagnosis lens model statistics

Tissue viability specialist nurses (TVSNs) vs. Generalist community nurses (GCNs)

Lens Statistics	TVSNs (n= 18)		GCNs (n= 18)			
	Mean	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Ra Achievement/ Accuracy	0.57	0.13	0.38	0.16	-3.89	<0.01*
Rs Cognitive Control	0.62	0.10	0.54	0.14	-1.98	0.06
G Knowledge	0.34	0.08	0.25	0.12	-2.61	0.01*
C_1 Unmodelled Knowledge	0.23	0.08	0.12	0.07	-4.11	<0.01*
C_2 Unmodelled Knowledge	0.00	0.01	0.00	0.00	-.99	0.33
C_3 Unmodelled Knowledge	0.00	0.01	0.01	0.02	1.45	0.16

*Statistically significant

The second nomothetic comparison compared the impact of education. Table 7.7 shows the lens model statistics for both groups but the only lens model statistic that was statistically significant and thus unlikely to be due to chance was that for unmodelled knowledge (C_1 - $t(34) = -2.23$, $p = 0.03$) There was a small to medium positive correlation between the 'more education' group's use of unmodelled knowledge (C_1 (18) = 0.21) and that of the ecology. This compared to a small positive correlation between the 'less educated' group's use of unmodelled knowledge and the ecology (C_1 (18) = 0.14). Therefore, no evidence was found to show that level of education had an impact on the nurses' diagnostic judgements.

Table 7.7 Diagnosis lens model statistics

More Education vs. Less Education

Lens Statistics	More Education (n= 18)		Less Education (n= 18)			
	Mean	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Ra Achievement	0.53	0.15	0.42	0.18	-1.92	0.06
Rs Cognitive Control	0.59	0.10	0.58	0.15	-.120	0.91
G Knowledge	0.32	0.08	0.29	0.13	-1.38	0.18
C_1 Unmodelled Knowledge	0.21	0.10	0.14	0.07	-2.23	0.03*
C_2 Unmodelled Knowledge	0.00	0.01	0.00	0.01	1.63	0.11
C_3 Unmodelled Knowledge	0.00	0.01	0.01	0.01	1.29	0.21

*Statistically significant

Judgement consistency on replication cases

As described earlier in this chapter, 'consistency' refers to the level of similarity between judgements on the same judgement profile, rather than similarity across the judgement task. Table 7.8 shows that the diagnostic ecology had a Phi coefficient of 0.99 which is close to 1.00 which indicates a high level of consistency for the expert panel's judgements which formed the ecology. Table 7.8 also shows the Phi coefficients for the overall nurse participants compared to the ecology. The nurse participants had a lower level of consistency for their diagnoses on the replication cases but this was still relatively high (Phi = 0.90).

Table 7.8 Judgement consistency on replica cases			
Cue	**Ecology**	**Nurse Participants (n= 36)**	
	Phi	**Mean Phi**	**SD**
Diagnosis	0.99	0.90	0.07

Table 7.9 shows the mean Phi coefficients of the TVSNs compared to the GCNs and alongside the ecology. In relation to the consistency for the diagnostic judgments, the TVSNs had a small but statistically significant higher level of achievement compared to the generalist nurses. Although both groups achieved a relatively high level of consistency, neither group achieved the level of consistency achieved in the ecology.

Table 7.9 Judgement consistency on replica cases **Tissue viability specialist nurses vs. Generalist community nurses**							
	Ecology	**TVSNs (n= 18)**		**GCNs (n= 18)**			
	Phi	**Mean Phi**	**SD**	**Mean Phi**	**SD**	**t(df34)**	**Sig (2-tailed)**
Diagnosis	0.99	0.94	0.05	0.87	0.08	-3.38	<0.01*

*Statistically significant

Table 7.10 compares the Phi coefficients of the 'more education' group with the 'less education' group but the difference was not statistically significant.

Table 7.10 Judgement Consistency on Replica cases **More education vs. Less education**							
	Ecology	**More Education (n= 18)**		**Less Education (n= 18)**			
	Phi	**Mean Phi**	**SD**	**Mean Phi**	**SD**	**t(df34)**	**Sig (2-tailed)**
Diagnosis	0.99	0.91	0.07	0.90	0.07	-0.56	0.58

Conclusions for accuracy in diagnosis

Overall, there was a medium to large correlation for accuracy of the diagnoses of nurses and a large correlation for cognitive control. However, there was only a low level correlation for knowledge (the use of evidence-based cue information) and unmodelled knowledge (non-evidence-based information). The TVSN group achieved a higher correlation for accuracy of diagnosis than the GCN group. The TVSN group also achieved higher correlations for knowledge and unmodelled knowledge compared to the GCN group. However, level of education did not seem to impact on the performance of the nurses. There was high judgement consistency on the replicated scenarios. The TVSNs had a slightly higher level of consistency compared to the generalist nurses but neither group achieved the level of consistency achieved in the ecology.

7.4. Confidence and diagnosis

Calibration analysis (Petrusic and Baranski, 1997) was used to assess the nurses' confidence about their diagnostic judgements. Overall, the proportion of correct diagnoses for the nurses overall was 72.85% (SD 9.16), the confidence level was 67.77% (SD 13.62) and overall, the nurses were under-confident by 5%. There was a statistically significant difference between the proportion correct of the TVSNs (mean 77.93 SD 6.89) and the proportion correct of the GCNs (mean 67.78 SD 8.42). There was also a statistically significant difference between the confidence level of the TVSNs (mean 72.53 SD 12.97) and the confidence level of the GCNs (mean 63.01 SD 12.87). However, no difference was found in the level of under-confidence between the TVSNs and the GCNs. No differences were found between the more educated and less educated nurses (see Tables 7.11 and 7.12).

Table 7.11 Calibration analysis for diagnosis
Tissue viability specialist nurses vs. Generalist community nurses

	All nurses		TVSNs (n= 18)		GCNs (n= 18)			
	Mean	SD	Mean	SD	Mean	SD	t(df 34)	Sig (2-tailed)
Proportion correct (%)	72.85	9.16	77.93	6.89	67.78	8.42	-3.96	<0.01*
Confidence level (%)	67.77	13.62	72.53	12.97	63.01	12.87	-2.21	0.03*
Over / Under Confidence %	-5	NA	-5	NA	-5	NA	-0.13	0.90
Calibration	0.57	0.17	0.58	0.13	0.57	0.21	-0.21	0.83
Normalised Resolution	0.21	0.12	0.18	0.11	0.24	0.14	-0.06	0.95
N Observations per nurse		110		110		110		

*Statistically significant

Table 7.12 Confidence for diagnosis
More Education vs. Less Education

	More Education (n= 18)		Less Education (n= 18)			
	Mean	SD	Mean	SD	t(df 34)	Sig (2-tailed)
Proportion correct (%)	75.40	8.40	70.30	9.42	-1.715	0.09
Confidence level (%)	70.40	12.67	65.14	14.38	-1.164	0.25
Over / Under Confidence%	-5.00	NA	-5.16	NA	.375	0.97
Calibration	0.60	0.16	0.55	0.18	-0.27	0.79
Normalised Resolution	0.20	0.17	0.22	0.12	0.41	0.68
N Observations Per Nurse		110		110		

The calibration score is the correspondence between subject's own assessment of their confidence in their own judgement and the empirical probability of that judgement being correct. '0' indicates perfect calibration while '1' indicates the worst possible calibration. The calibration score for the nurses overall was 0.57 (SD 0.17) so the nurses' own assessment of their confidence in relation to the accuracy of their diagnoses was not well calibrated. There was no difference between the calibration scores of the TVSNs and the GCNs or between the more educated and less educated nurses.

Resolution is the measurement of an individual's ability to use their confidence ratings to discriminate between correct and incorrect judgements and normalised resolution scores range from 0 to 1 with a higher score indicating a higher ability to differentiate between correct and incorrect answers. The normalised resolution score for the nurses overall in relation to diagnosis was 0.21 (SD 0.17) which indicated that the nurses had low ability in discriminating between correct and incorrect diagnoses. There was no difference between the normalised resolution scores of the TVSNs and the GCNs or between the more educated and less educated nurses.

Figure 7.1 shows the confidence calibration curve for the nurses overall. There was a clear cut off point for under-confidence and over-confidence at 45%. At confidence ratings below 45% the nurses tended to be under-confident but at confidence ratings above 45% the nurses tended to be over-confident.

Figure 7.1 Confidence Calibration Curve Diagnosis - Nurses overall

Figure 7.2 shows the confidence calibration curve for the TVSNs' diagnoses compared to that of the GCNs. To minimise the risk of bias, confidence categories which had less than five responses were omitted when plotting the calibration curves. The calibration curves were similar for TVSN and GCN group and reflected the calibration curve for the nurses overall. Below 45% the nurses tended to be under-confident but at confidence ratings above 45% the nurses tended to be over-confident.

Fig 7.2.Confidence calibration curve Diagnosis - Tissue viability specialist nurses vs. generalist community nurses

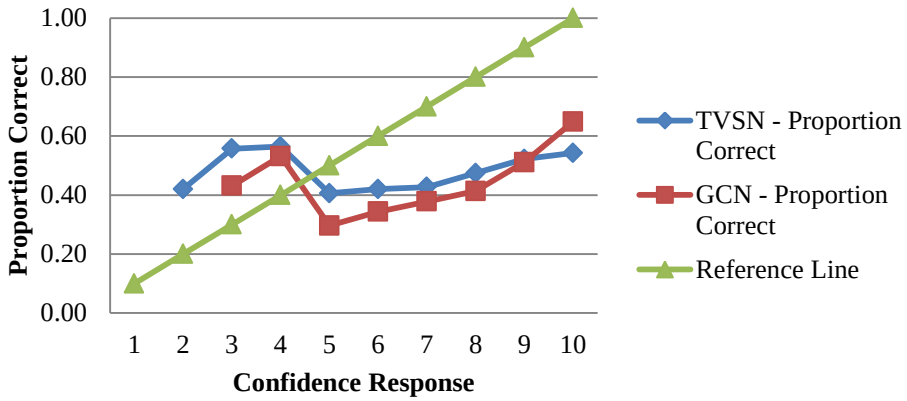
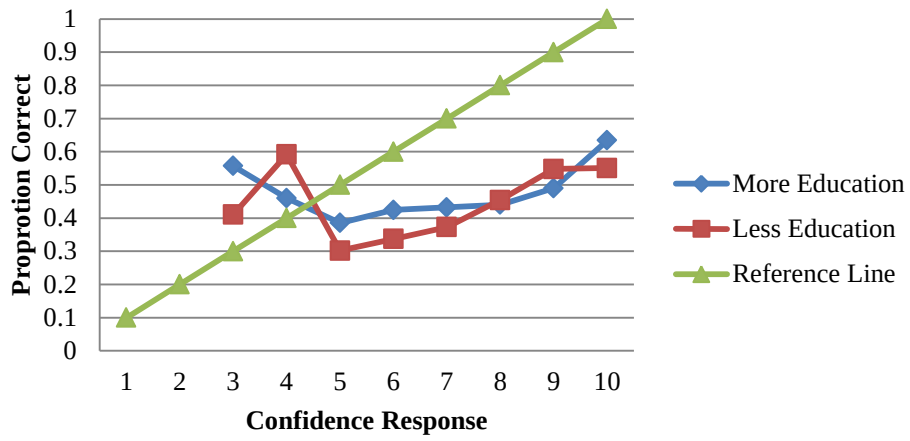


Figure 7.3 shows the confidence calibration curve for the diagnoses of those nurses with more education compared to those with less education. To minimise the risk of bias, confidence categories which had less than five responses were omitted when plotting the calibration curves. The calibration curves were similar for nurses with more education and those with less education and again, reflected the curves of the TVSN and GCN group and the calibration curve for the nurses overall. Below 45% the nurses tended to be under-confident but at confidence ratings above 45% the nurses tended to be over-confident.

Fig 7.3 Confidence calibration curve
Diagnosis - More education vs less education



There was also evidence of under-confidence in relation to diagnosis in the comments made by the nurses when exiting the Judgement task. Many of the nurses made comments such as:

"Very difficult to make confident decisions"

"I found it very difficult to make a clinical decision"

"Surprised at how little confidence I had!"

Conclusions regarding nurse confidence for diagnosis

The mean confidence levels of the nurses overall showed that the nurses were under-confident by 5 but when the nurses' performance was scrutinised using calibration curves it became evident that the nurses were under-confident below a confidence level of 45% confidence but over-confident above this level. This pattern occurred in the comparisons between TVSNs and GCNs and between nurses with more education and those with less education. There was evidence of only modest calibration between levels of confidence and accuracy and low ability to discriminate between correct and incorrect diagnostic judgements. The TVSNs had a larger proportion of correct diagnoses compared to the GCNs and demonstrated higher levels of confidence but this was the only evidence of a difference between the TVSNs and the GCNS and the more

and less educated groups of nurses. The significance of these results within the context of clinical practice will be discussed in Chapter 9.

7.5. Cognition and diagnosis

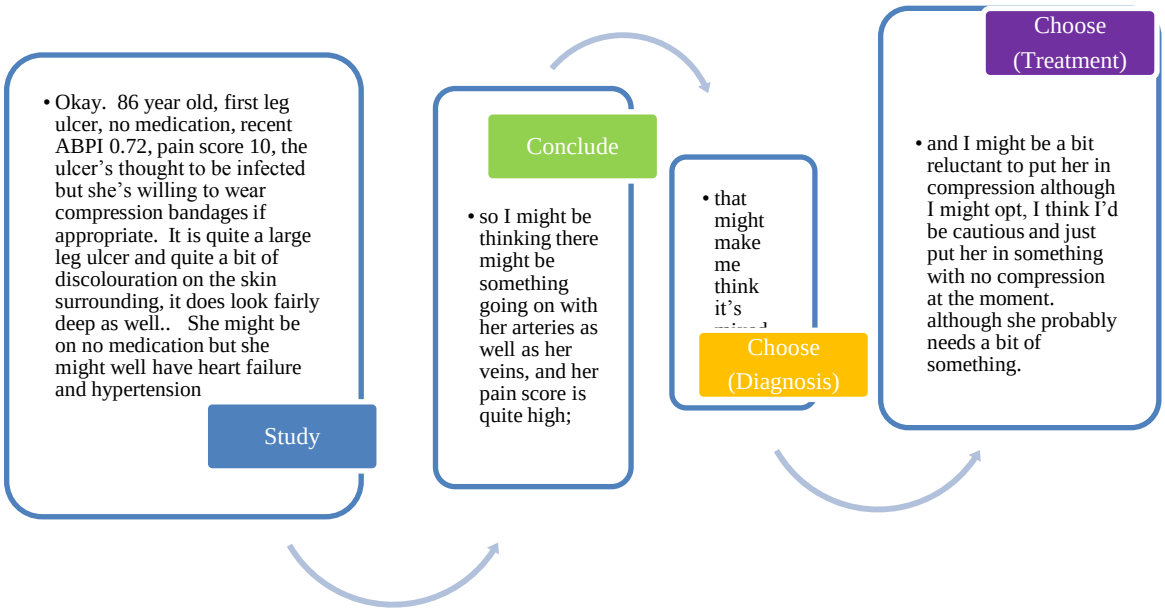
7.5.1. Reasoning processes

The primary aim of the analysis of the TA data was to detect patterns of predominant reasoning processes. Operators from the script analysis were collated in chronological order to identify any recurring patterns. Once the process of SA had been completed, the different SA operators were colour coded to enable easier identification of the chronological order of reasoning. This was undertaken for the first 15 scenarios for each GCN respondent and the results compiled into a table (Table 7.13).

The following predominant patterns of reasoning emerged from the data. As would be expected, a period of study preceded the diagnostic judgement and treatment decision for all scenarios. However, after this initial study period, several different patterns emerged. Sometimes there would be a period of reflection when participants proceeded in a linear fashion from 'study', to 'conclude' to a diagnostic 'choice' and then a treatment 'choice' (with sometimes an 'explanation' at some points in the process although the distinction between 'conclude' sometimes blurs into 'explain' possibly due to the requirements of TA to verbalise swift thought processes). (GN1 Scenarios 2,8,11 and 14, GN2 Scenarios 2, 9 11 and 14), GN3 Scenarios 8,11, 12, 14) (Fig. 7.4)

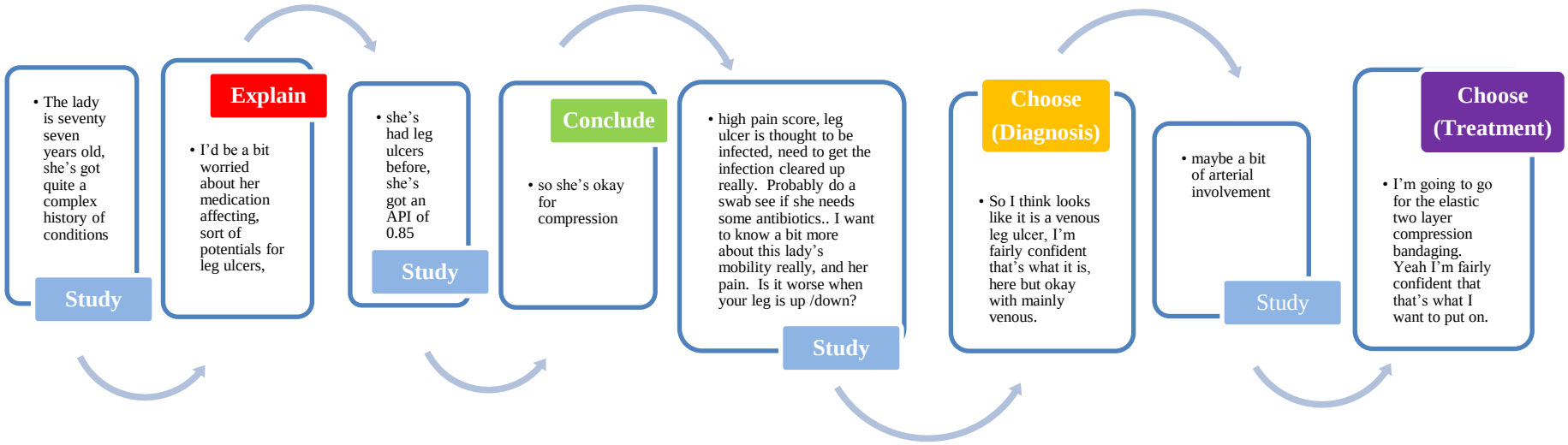
Table 7.13 Reasoning Processes of the Generalist Nurses

Figure 7.4 Reasoning Process 1 - Simple Linear (GN3 Scenario 8)



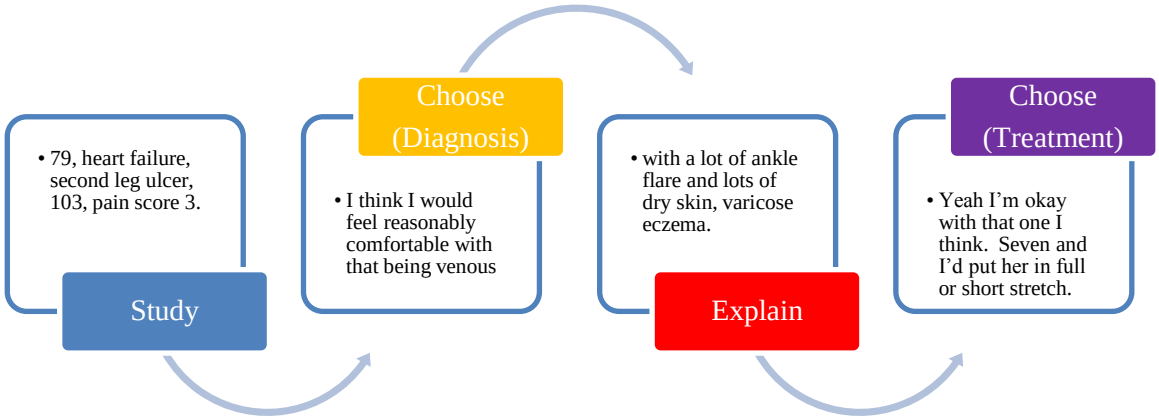
Sometimes, although a linear reasoning process was still evident, it was more convoluted as the participant studied the information, drew conclusions and gave explanations while returning to study the information before choosing a diagnosis and treatment (GN1 Scenarios 1,3,9,10,12 and 15, GN2 Scenarios 1,6 and 7, GN3 Scenarios 1,4,6,7,13and 15). (Fig. 7.5)

Figure 7.5 Reasoning Process 2 – Complex Linear (GN1 Scenario 1)



In a number of cases, the TA data appeared to indicate that a diagnostic choice was made prior to any conscious reflection ('conclude') or rationalisation ('explain'). (GN1 Scenarios 4, 5,6,7, GN2 Scenarios 3,4,5,10,12,13, and 15, GN3 Scenario 2). (Fig. 7.6)

Figure 7.6 Reasoning Process 3 - Simple Intuition (GN2 Scenario 5)



In such cases, the choices were always followed by an 'explain' to give post-hoc rationalisation to that choice. However, in some cases this initial diagnosis was followed by a more complex reasoning process before a final diagnosis was chosen which suggests that the initial diagnostic choice was a tentative choice which was then tested by reflection and rationalisation (GN1 Scenarios 4, 5 and 6, GN2 Scenarios 3,4,13 and 14). (Diagram 7.7)

Diagram 7.7 Reasoning Process 4 – Complex Intuition (GN2 Scenario 4)

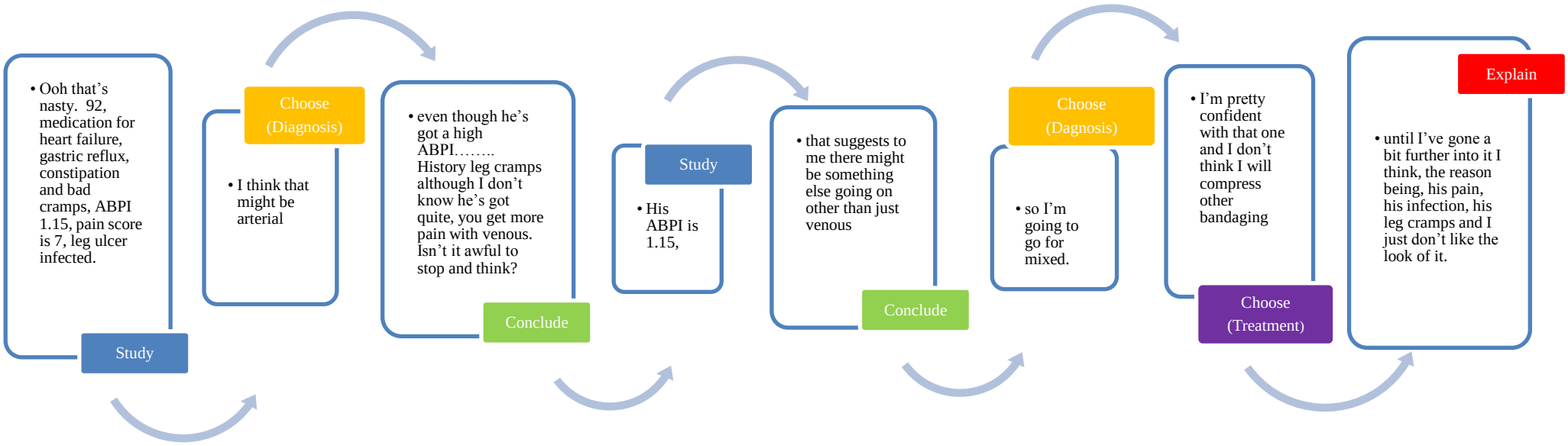
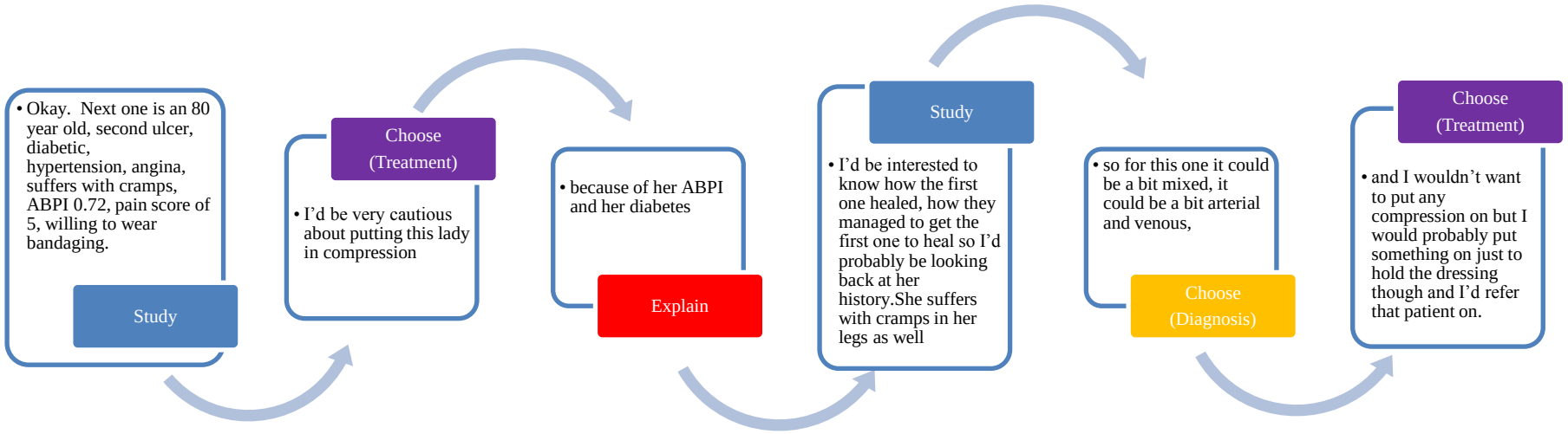


Figure 7.8 Reasoning Process 5 – Reverse Complex Intuition (GN3 Scenario 5)

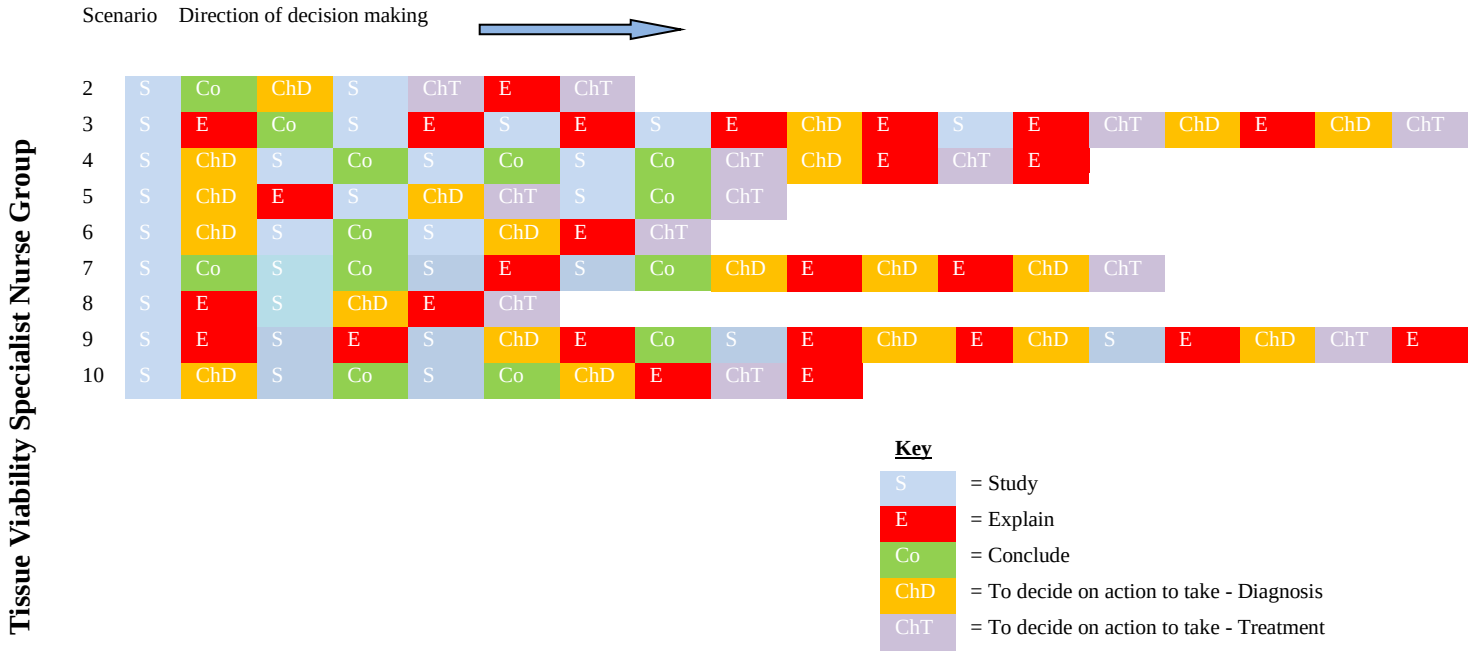


In a few cases, the choice of treatment was verbalised before the choice of diagnosis (GN1 Scenario 13, GN2 Scenario 8, GN3 Scenarios 5, 9, and 10) (Fig. 7.8). In one case, the treatment choice was verbalised immediately following 'study' and without any verbalisation of conscious reflection ('conclude') or rationalisation ('explain') (GN3 Scenario 5).In another case, only the treatment choice was verbalised (i.e. no diagnostic choice was verbalised) (GN3 Scenario 9).

In almost two thirds of the GCN's TA data (66.5% of the scenarios) the treatment choice was adjacent to the diagnosis choice with no intermediate verbalisation to indicate reflection or rationalisation specific to each individual choice. This partnering of diagnosis and treatment suggests that cognition for both diagnosis and treatment is often interwoven rather than being treated as two separate decision making processes. Where verbalisation had separated the diagnostic and treatment choices, in only 10 scenarios was there evidence that conscious reflection ('conclude') or rationalisation ('explain') had occurred between the diagnostic and treatment choices. Even when there was verbalisation between the diagnostic judgement and the treatment decision, it was often explanatory explaining the diagnostic choice rather than verbalising the cognitive process for the treatment choice. The data suggested that the diagnostic judgement required greater cognitive effort than the treatment decisions.

Outlined in Chapter 5, data from the specialist nurses was collected during the formulation of group judgments. This data was not indicative of independent clinical cognition and the application of the three step coding process of Fonteyn et al' (1993) would have been inappropriate. Thus, the reasoning processes of the expert group were mapped using the same approach used with the individual generalist nurses to provide a thematic analysis (Table 7.14). There were similarities in that a period of studies preceded the judgement and decision making for each scenario, convoluted reflection which alternated between tentative diagnoses, explanations and conclusions was evident and there was consistently considerably more discussion about the diagnostic choice compared to the amount of discussion about the treatment choice. The judgement and decision making processes were considerably more extended than those of the generalist nurses but this was to be expected as the expert group was required to reach a group consensus.

Table 7.14 Reasoning Processes of the expert nurse group



Overall the data showed that the participants followed a variety of reasoning processes but there was no evidence to suggest that particular participants had a strong preference for certain types of reasoning. Instead it appeared that the participants adjusted their cognitive approach to cope with the perceived complexity of the scenario and their own level of knowledge in relation to the demands of that scenario. There was also no evidence to suggest that as the participants progressed through the judgement task they adopted a more intuitive approach as they became more familiar with the demands of the judgement task. Overall, although five predominant reasoning processes were identified, there was no evidence to suggest that any one of these was dominant.

7.5.2. Rationale for diagnostic judgements

As described above, in most scenarios the nurse participants verbalised a rationale for their diagnostic judgements but this was nearly always very brief. There were some recurring elements: the ABPI is frequently mentioned with regard to the diagnostic choice,

> "*okay we're getting leg cramps, he's got high arterial brachial pressure index, suggesting sort of more of an arterial involvement in this one."*
> (GN1 Scenario 4)

However, other cues were also mentioned within the rationale for the diagnosis including appearance,

> *"Oh look at that it's a beauty. It's round, I would say…he's got quite a lot of staining, he's got little blots of fibre sets, I think I would reasonably comfortably say that's venous."* (GN2 Scenario 3)

clinical history,

> *"Going by the history it's probably a venous ulcer"* (GN3 Scenario 2)

age,

> *"and his age so I think at the moment he could be a bit of a mixed venous and arterial insufficiency."* (GN3 Scenario 1)

and pain,

> *"Quite a high pain score, I'm not too happy about that…… Again I think it could be mixed"* (GN 2 Scenario 2).

Overall, no clear picture emerges to indicate the rationales behind the diagnostic judgement. The brevity of the verbalised rationales suggested that these are incomplete snapshots of the nurse participants' cognitive processing.

7.6. Conclusion

This chapter has presented the results in relation to diagnosis. The ABPI was the most important cue by far in both the ecology model and for the nurses. 'Medical history' was the next most important cue for both the ecology model and the nurses but the nurses under-valued this cue compared to the ecology model. 'Appearance' was also under-used by the nurses but 'pain' and 'age' were over-used. The Think Aloud data and qualitative data from the exit page of the judgement task showed that in addition to the cues provided within the patient scenarios, the nurse participants sought more detailed information than had been provided within the scenarios to support their diagnostic judgement, particularly about pain and the ABPI.

There was a medium to large correlation between the community nurses' diagnostic judgements and those of the ecology but a low correlation between the nurses' ability to use the information that the evidence bases suggests is relevant and that of the ecology model. Judgement consistency on the replicated scenarios was high but the nurses were under-confident about their diagnostic judgements.

Expertise as defined by job role had an impact on a number of aspects of diagnosis. The diagnoses of the TVSNs were more accurate than those of the GCNs. The TVSNs were also better at using the evidence-based cue information and non-evidence based information than the GCNs. However, level of education did not seem to make a difference in relation to diagnosis. The Think Aloud data suggested that the 'more

expert' TVSNs sought different types of additional information to that sought by the GSNs.

The Think Aloud data found that the nurse participants used a wide range of cognitive processes when making diagnostic judgements about venous leg ulceration. It seemed likely that the perceived complexity of the scenario and the nurses' own knowledge base affected the choice of cognitive approach rather than particular nurses or particular scenarios being associated with certain types of reasoning.

The clinical implications of these results will be considered in the discussion chapter (Chapter 9). The next chapter will present the results that relate to the treatment judgements.

CHAPTER 8

RESULTS: PART 3

TREATMENT FOR VENOUS LEG ULCERATION.

This chapter reports the results about how the nurses chose treatments. It describes how the nurses used the information in the patient scenarios to choose whether or not to apply high compression therapy and evaluates the 'accuracy' of those choices in terms of the choices made in the ecology model. The performance of the specialist nurses and the generalist nurses are compared as is the performance of the 'more educated' and 'less educated' groups of nurses. Judgement consistency on replicated scenarios is evaluated along with the relationship between the participants' levels of 'accuracy' and their confidence in their treatment choices. Finally, the cognitive approaches used by the nurses in relation to their treatment choices will be described.

8.1. The predictability of the Lens Model for treatment

As discussed in Chapter 7, the predictability parameter of a Lens Model represents the degree to which the model will vary in how well it predicts the 'correct' choice (the ecological criterion). A model which predicts perfectly would achieve a correlation of 1.00 ($R_e = 1$). The predictability of the Lens Model for treatment ($R_e = 0.88$) indicates that it is an imperfect predictive model.

8.2. The use of treatment information

8.2.1.Cue Weightings

Relative cue weights were calculated to indicate the importance of each cue in the treatment choice. The ecology model cue relative weights for treatment are shown in Table 8.1 in rank order alongside those of the nurses. The 'diagnosis of the type of leg ulcer' was the most important cue by far for both the ecology model and the nurses. However, this cue had more importance in the ecology model than in the nurses'

treatment judgements. The next most important cue in the ecology model was 'pain' but for the nurses this was one of the least important cues. The nurses gave more importance to 'patient's preferences' and 'infection' than was given in the ecology model. 'Gender' was given very low weighting in the ecology but the nurses regarded it as of the same importance as pain' and 'exudate level'.

Table 8.1 Relative weights for cues for treatment - Ecology vs nurse participants

Cue	Ecology		Nurse Participants (n= 36)		
	Rank	**Weight**	**Rank**	**Mean Weight**	**SD**
Diagnosis of leg ulcer type	1	68	1	56	19.22
Pain	2	13	4	7	7.52
Infection	3	8	2	12	13.75
Exudate levels	4	7	4	7	5.1
Patient preferences re compression	5	4	2	12	8.26
Gender	6	1	5	6	6.68

Table 8.2 shows the treatment cue relative weights for the tissue viability specialist nurse group and the community generalist nurse group alongside the ecological cue relative weights but none of the differences were statistically significant.

Table 8.2 Relative weights for cues for treatment

Tissue viability nurses vs. Generalist community nurses

Cue	Ecology		TVSN (n= 18)			GCN (n= 18)				
	Rank	Weight	Rank	Mean Weight	SD	Rank	Mean Weight	SD	t(df 34)	Sig (2-tailed)
Diagnosis of leg ulcer type	1	68	1	58	18.72	1	55	20.10	-0.81	0.42
Pain	2	13	4	8	8.57	6	6	6.43	-0.71	0.48
Infection	3	8	2	11	15.75	2	12	11.87	NA[a]	0.47
Exudate levels	4	7	5	7	4.74	5	7	5.55	-0.06	0.95
Patient preferences re compression	5	4	2	11	6.57	2	12	9.82	0.24	0.81
Gender	6	1	6	5	4.72	4	8	8.08	1.14	0.26

[a]Mann Whitney Test

Table 8.3 shows the treatment cue relative weights for the 'more education' group and the 'less education' group alongside the ecological cue relative weights but again, none of the differences were statistically significant.

Table 8.3 Relative weights for cues for treatment
More education vs. Less education

Cue	Ecology		More Education (n= 18)			Less Education (n= 18)				
	Rank	Weight	Rank	Mean Weight	SD	Rank	Mean Weight	SD	t(df 34)	Sig (2-tailed)
Diagnosis of leg ulcer type	1	68	1	58	20.10	1	55	18.66	-0.72	0.42
Pain	2	13	4	8	8.42	5	5	6.49	-1.00	0.48
Infection	3	8	3	11	11.58	2	10	15.89	NA[a]	0.64
Exudate levels	4	7	5	7	4.94	5	5	5.38	-0.66	0.95
Patient preferences re compression	5	4	2	12	8.28	3	9	8.49	-0.23	0.81
Gender	6	1	6	4	4.77	4	7	7.71	1.81	0.26

[a]Mann Whitney Test

8.2.2. Identification of treatment cues

The think-aloud data revealed that in relation to choosing treatment, the GCNs would have liked more information about the patients' levels of mobility. They also expressed a wish for more information about how those patients with a previous history of leg ulceration had achieved healing. The expert group would have liked more information about patients' ability to communicate and their mental capacity for making responsible and appropriate decisions should their bandaging become uncomfortable or painful.

The exit page of the judgement task also provided information about the additional cues that some participants would have sought to use in their decisions about their treatment choices. Again, the comments broadly followed the information obtained from the TA analysis. The GCNs would have liked more information about the nature of patients'

pain but they also sought more information about dexterity or available assistance in relation to deciding whether to prescribe bandaging or hosiery. The TVSNs again mirrored the TA data in wishing to have more detailed information about pain but one TVSN also sought more information about appearance and size of the whole affected limb.

8.3. Accuracy and treatment

8.3.1. Treatment Lens Model analysis

Idiographic treatment Lens Model analysis

Table 8.4 shows the mean lens model statistics which were calculated from the individual nurses. There was a medium to large positive correlation for achievement (R_a (36) = 0.49) and very large positive correlation for cognitive control (R_s (36) = 0.78) which indicates the nurses level of consistency in assigning a similar amount of 'weight' to a cue when making treatment choices. There was a medium positive correlation for knowledge (G (36) = 0.33) which relates to the nurses' use of information that the evidence base suggests is relevant to treatment choices. The correlation for the use of unmodelled knowledge by the expert group and that of the nurse participants was positive but small (C_1 (36) = 0.16, C_2 (36) = 0.00, C_3 (36) = 0.00).

Table 8.4 Aggregated treatment lens model statistics for all nurse participants

Lens Statistics	Mean	SD	N
Ra Achievement/Accuracy	0.49	0.18	36
Rs Cognitive Control	0.78	0.13	36
G Knowledge	0.33	0.14	36
C_1 Unmodelled Knowledge	0.02	0.03	36
C_2 Unmodelled Knowledge	0.09	0.07	36
C_3 Unmodelled Knowledge	0.05	0.03	36

Nomothetic comparisons of the treatment Lens Model analysis

Table 8.5 shows that there was a large positive correlation between the treatments chosen by the TVSNs and those of the ecology model (Ra (18) = 0.57) but only a medium to large positive correlation between the treatments chosen by the GCNs and those of the ecology model (Ra (18) = 0.41). This difference was statistically significant (t (34) = -3.04, p = 0.01) and shows that the TVSNs were more accurate than the GCNs. There was also a medium to large positive correlation between the TVSN's knowledge and knowledge in the ecology model (G (18) = 0.39) but a lower small to medium positive correlation between the GCNs' knowledge and knowledge in the ecology model (G (18) = 0. 26). This difference was statistically significant (t (34) = -3.19, p = <0.01) and shows that the TVSNs had a higher level of ability or 'knowledge' in managing the information that the evidence base suggests is relevant. There was a statistically significant difference (t(34)= - 2.47, p = 0.02) between the TVSN's use of unmodelled knowledge (C_3 (18) = 0.06) and that for the GCNs, but the correlations were both so small as to be negligible. None of the other key Lens Model statistic comparisons achieved statistical significance.

Table 8.5 Treatment lens model statistics

Tissue viability specialist nurses vs. Generalist community nurses

Lens Statistics	**TVSNs (n= 18)**		**GCNs (n= 18)**			
	Mean	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Ra Achievement/Accuracy	0.57	0.14	0.41	0.18	-3.04	0.01*
Rs Cognitive Control	0.80	0.11	0.76	0.15	-0.93	0.36
G Knowledge	0.39	0.11	0.26	0.13	-3.19	0.00
C_1 Unmodelled Knowledge	0.09	0.03	0.02	0.03	0.52	0.60
C_2 Unmodelled Knowledge	0.11	0.08	0.09	0.07	-0.57	0.58
C_3 Unmodelled Knowledge	0.06	0.03	0.03	0.03	-2.47	0.02

*Statistically significant

Table 8.6 shows that there was a large positive correlation between the treatments chosen by the nurses with more education (R_a (18) = 0.56) and those of the ecology model compared to a medium to large positive correlation between the treatments chosen by the nurses with less education (R_a (18) = 0.42) and those of the ecology model. This difference was statistically significant (t (34) = -2.70, p = 0.01) and therefore nurses with more education were more accurate in their treatment choices about the application of high compression than nurses with less education. None of the other key lens model statistic comparisons achieved statistical significance.

Table 8.6 Treatment lens model statistics

More education vs. Less education

Lens Statistics	**More Education (n= 18)**		**Less Education (n= 18)**			
	Mean	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Ra Achievement/Accuracy	0.56	0.15	0.42	0.18	-2.70	0.01*
Rs Cognitive Control	0.79	0.12	0.77	0.15	-0.29	0.77
G Knowledge	0.36	0.13	0.29	0.14	-1.69	0.10
C_1 Unmodelled Knowledge	0.03	0.03	0.01	0.03	-1.64	0.11
C_2 Unmodelled Knowledge	0.12	0.08	0.08	0.07	-1.68	0.10
C_3 Unmodelled Knowledge	0.05	0.03	0.04	0.03	-1.52	0.14

- Statistically significant

A larger proportion of tissue viability specialist nurses than generalist community nurses were more highly educated so it was possible that there was an interaction effect between job role and level of education. However, two way repeated measures ANOVAs found no evidence to suggest an interaction between the effect of education and the effect of job role in diagnostic sensitivity (F (1,32) = 0.15, p = >0.05), diagnostic specificity (F (1,32) = 0.22, p = >0.05), treatment sensitivity (F (1,32) = 0.29,

p = >0.05) or treatment specificity (F (1,32) = 0.34, p = >0.05) so in this study, education alone was not related to the level of accuracy of diagnosis or treatment.

Judgement consistency on replication cases

With regard to the 'consistency' (level of similarity between choices on the same judgement profile, rather than similarity across the judgement task) Table 8.7 shows that the treatment ecology had a Phi coefficient of 0.99. This is close to 1.00 and indicates that the expert panel's choices which formed the ecology were highly consistent. Table 8.7 also shows the Phi coefficients for the overall nurse participants compared to the ecology. The nurse participants had a lower level of consistency for their treatment choices on the replication cases but this was still relatively high (Phi = 0.90).

Table 8.7 – Judgement consistency on replica cases

	Ecology	**Nurse Participants (n= 36)**
	Phi	**Mean (SD)**
Treatment	0.99	0.90 (0.07)

Table 8.8 compares the Phi coefficients of the Tissue Viability Specialist Nurses with the generalist nurses and the ecology but the difference was not statistically significant.

Table 8.8 Judgement consistency on replica cases
Tissue viability specialist nurses vs. Generalist community nurses

	Ecology	**TVSN (n= 18)**	**GCN (n= 18)**		
		Mean (SD)	**Mean (SD)**	**t(df34)**	**Sig (2-tailed)**
Treatment	0.99	0.92 (0.05)	0.88(0.09)	-1.64	0.11

Table 8.9 compares the Phi coefficients of the 'more education' group with the 'less education' group but again the difference was not statistically significant.

Table 8.9 Judgement Consistency on replica cases **More education vs. Less education**					
	Ecology	**More Education (n= 18)**	**Less Education (n= 18)**		
		Mean (SD)	**Mean (SD)**	**t(df 34)**	**Sig (2-tailed)**
Treatment	0.99	0.91 (0.06)	0.90 (0.09)	-0.53	0.60

Conclusions for accuracy in treatment

Overall, there was a medium to large correlation in relation to the accuracy of the nurses' treatment choices and a very large positive correlation in relation to the consistency with which the nurses weighted the individual cues. There was a medium positive correlation for how the nurses used the information that the evidence base suggests is relevant to treatment choices. However, the TVSNs were more accurate than the GCNs in their treatment choices and were more able to use evidence based information. Nurses with more education were also more accurate in their treatment choices than those with less education. Consistency on the replicated scenarios was high although it was higher across the ecology treatment choices than across the nurse participants' treatment choices.

8.4. Confidence and treatment

Calibration analysis was used to assess the nurses' level of confidence about their treatment choices as to whether or not to apply high compression. The proportion of 'correct' treatment choices (i.e. that matched those in the ecology) for the nurses overall was 73.00% (SD 8.20), the confidence level was 68.21% (SD 13.26) and overall, the nurses were under-confident by 5.08%. There was a statistically significant difference between the proportion correct of the TVSNs (mean 76.66 SD 6.01) and the proportion correct of the GCNs (mean 69.34 SD 8.59 t (34) = -2.96, P = 0.01). There was also a

statistically significant difference between the confidence level of the TVSNs (mean 73.32 SD 12.65) and the confidence level of the GCNs (mean 63.10 SD 12.12 t (34) = -2.47, P = 0.02). However, no difference was found in the level of under-confidence between the TVSNs and the GCNs. A statistically significant difference was found in the proportion of correct treatment choices between the nurses with more education (Mean 76.36%), SD 6.90) and the nurses with less education (Mean 69.65, SD 8.17), t (34) = -2.66, P = 0.01) but no other differences were found between the TVSNs and the GCNs and the more educated and less educated nurses (see Tables 8.10 and 8.11).

Table 8.10 Calibration analysis for treatment
Tissue viability specialist nurses vs. Generalist community nurses

	All Nurses		**TVSN (n= 18)**		**GCN (n= 18)**			
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Proportion correct (%)	73.00	8.20	76.66	6.01	69.34	8.59	-2.96	0.01*
Confidence level (%)	68.21	13.26	73.32	12.65	63.10	12.12	-2.47	0.02*
Over / Under Confidence %	-5.08	NA	-3.34	NA	-6.24	NA	0.70	0.49
Calibration	0.26	0.10	0.27	0.10	0.26	0.11	-0.04	0.96
Normalised Resolution	0.21	0.14	0.18	0.15	0.24	0.13	1.42	0.16
N Observations per Nurse		110		110		110		

Table 8.11 Calibration analysis for treatment More educations vs. Less education						
	More Education (n= 18)		**Less Education (n= 18)**			
	Mean	**SD**	**Mean**	**SD**	**t(df 34)**	**Sig (2-tailed)**
Proportion correct (%)	76.36	6.90	69.65	8.17	-2.66	0.01*
Confidence level (%)	71.35	12.02	65.06	14.03	-1.44	0.16
Over / Under Confidence%	-5.01	NA	-4.59	NA	-.103	0.92
Calibration	0.27	0.12	0.26	0.10	-0.27	0.79
Normalised Resolution	0.20	0.17	0.22	0.12	0.41	0.68
N Observations per nurse		110		110		

The calibration score for the nurses overall was 0.27 (SD 0.12). '0.00' indicates perfect calibration while '1.00' indicates the worst possible calibration so the nurses' own assessment of their confidence in relation to the accuracy of their treatment choices was fairly well calibrated. There was no difference between the calibration scores of the TVSNs and the GCNs or between the more educated and less educated nurses. However, the normalised resolution score for the nurses overall in relation to treatment choices was 0.20 (SD 0.17) which indicated that the nurses' ability to discriminate between correct and incorrect treatment choices was low since normalised resolution scores range from 0 to 1 with a higher score indicating a higher ability to differentiate between correct and incorrect answers.

Calibration curve analysis

Figure 8.1 shows the calibration curve for the nurses overall. To minimise the risk of bias, confidence categories which had less than five responses were omitted when plotting the calibration curves. There was a cut off point for under-confidence and over-confidence at 80% with nurses showing under-confidence below this point. However, between 40% confidence and 80% confidence there was an increasingly close

relationship between confidence and accuracy and between 80-90% confidence there was a very close relationship.

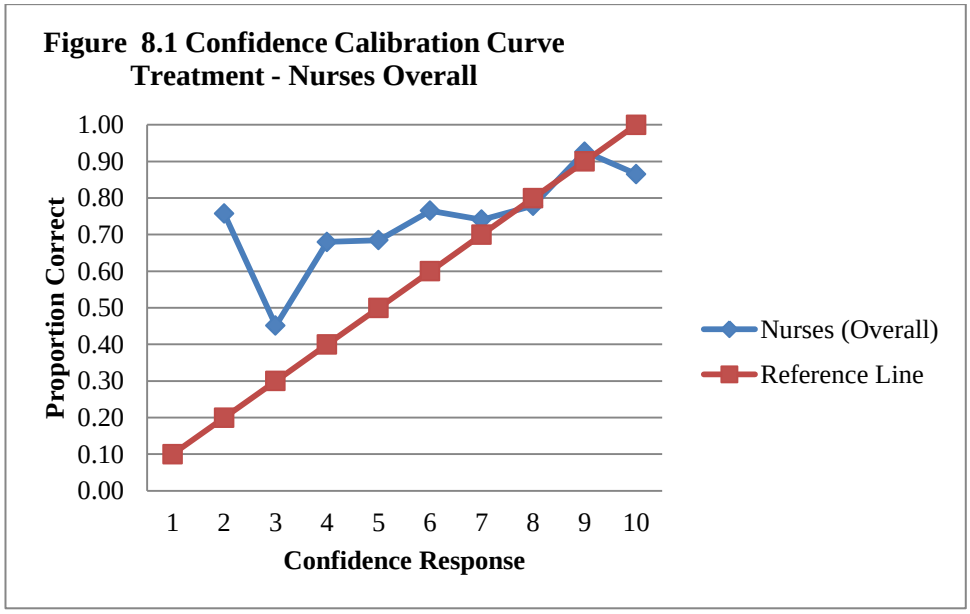


Figure 8.2 shows the calibration curves for the TVSNs compared to the GCNs. The cut off point for the TVSNs was at 80% with these nurses showing under-confidence before this point. The cut off point for the GCNs was 70%.

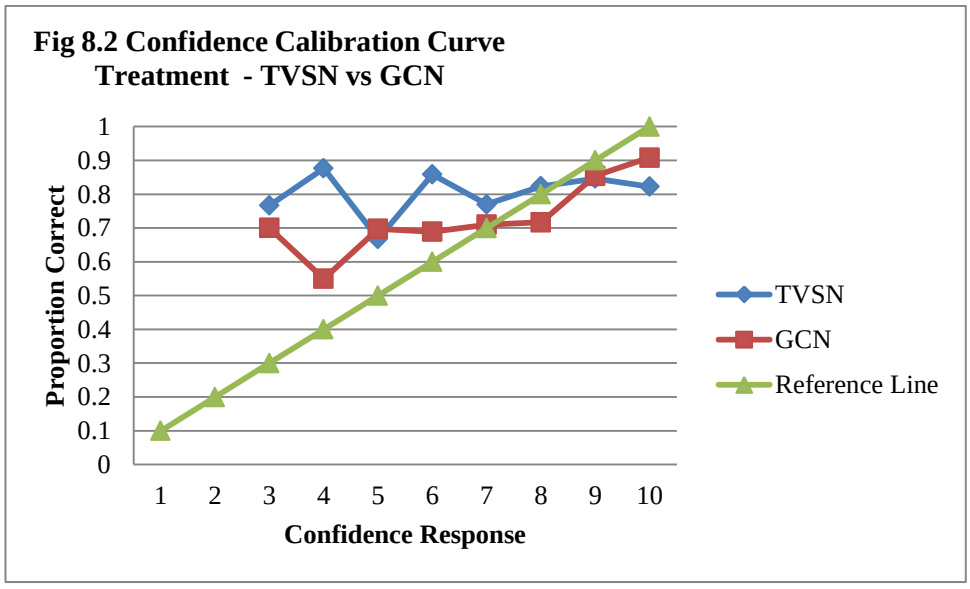
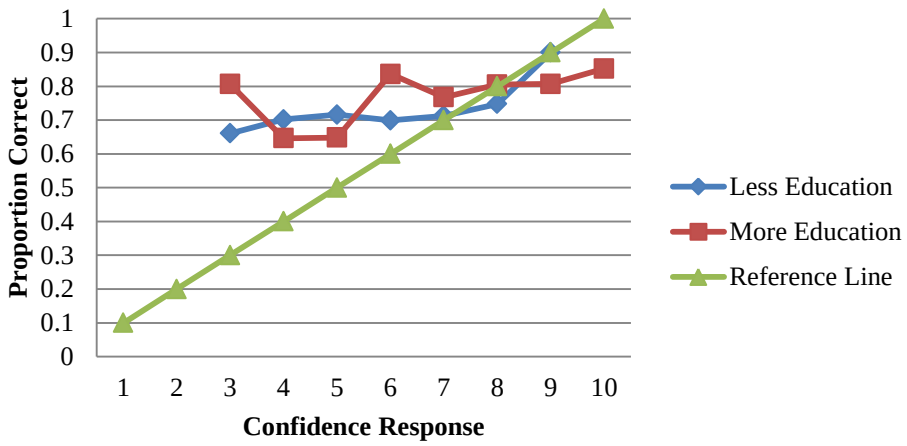


Figure 8.3 shows the calibration curve of the nurses with more education with the curve of nurses with less education. Both groups of nurses were under-confident until the cut off point of 80% confidence but the TVSNs had higher levels of confidence compared to the GCNs.

Figure 8.3 Confidence Calibration Curve
Treatment - More Education vs Less Education



There was also evidence of under-confidence in the Think Aloud data with nurses expressing concerns such as:

> *"if I was uncertain I would also be a bit unsure about compression" (S3)*

> *"I'm feeling very confident it's a safe decision but whether it is the ultimately the right decision.....?" (S5)*

> *"I'm not confident…… and I won't compress because I need to phone the Tissue Viability Nurse" (N2)*

Conclusions for confidence in treatment judgements

The mean confidence levels of the nurses overall showed that the nurses were under-confident by 5%. However, when the nurses' performance was scrutinised using calibration curves it became evident that below a confidence level of 80% confidence, the nurses were under- confident but between 40% and 80% confidence, the nurses became decreasingly under-confident and between 70% and 90% confidence there was a close calibration between confidence and the proportion of correct treatment choices. The confidence calibration curves of the TVSNs and GCNs and those of the nurses with more education and those with less education were similar to each other. However, the fairly high level of calibration between levels of confidence and accuracy was accompanied by low ability to discriminate between correct and incorrect treatment choices. The TVSNs demonstrated higher levels of confidence compared to the GCNs but this was the only evidence of any differences between the TVSNs and the GCNS and the more and less educated groups of nurses. The clinical implications of these results will be considered in the next chapter.

8.5. Cognition and treatment

8.5.1. Reasoning processes

Chapter 7 described how the patterns of predominant reasoning processes in the Think Aloud data interwove the reasoning processes for the diagnostic judgement and the treatment choices in a variety of reasoning approaches which ranged from un-verbalised, apparently intuitive cognition through to rationalised and reflective linear reasoning. It was noted that in a significant proportion (66.5%) of the scenarios, there was no verbalisation between the GCN's diagnosis and their treatment choice. In the 20% of scenarios where verbalisation had separated the diagnosis and treatment choice to suggest conscious reflection or rationalisation of these, this was usually to explain the diagnosis rather than verbalise the cognitive process for the choice of treatment. The consistent lack of verbalisation between the diagnoses and the accompanying treatment choices suggested that the participants were using a decision rule to make these treatment choices.

*"her ankle brachial pressure index is 1.03, pain score is three so this lady is looking very much she would be safe with compression." (*GN1 Scenario 6)

Analysis of the expert group data supported the theory of the existence of a treatment heuristic. Towards the beginning of the judgement task, it became apparent to the group that they were using slightly different decision rules to reach their treatment judgements and they spontaneously decided to agree a shared decision rule.

"Shall we make an agreement then that if we're happy it's venous then with the compression shall we always go for the 4 layer?" (EG 21.09)

Overall, although there was no evidence to suggest that particular participants had a strong preference for certain types of reasoning with regard to the diagnosis, the evidence did suggest that the nurse participants often drew on a decision rule that linked the diagnosis of venous leg ulceration with high compression to reach their treatment judgements.

8.5.2. Rationale for treatment choices

As described above, the rationale for the treatment choices was often un-verbalised or very briefly verbalised. The cue weightings had revealed that nurse participants had attributed most weight to the ulcer diagnosis. This cue was rarely verbalised within the rationale for the treatment choice but occasionally a verbal link was made.

"I think I would just treat this as straightforward venous ulceration. I'm going to go for an elastic two layer compression bandaging." (GN1, Scenario 10)

The verbalisation that did occur was mostly related to cues other than the diagnosis cue such as the pain score,

"quite a high pain score, I'm not happy about that". (GN2 Scenario 2)

the clinical history,

> *"just wouldn't be happy to put full compression onto that with his history, and looking at the ulcer as well."*(GN1 Scenario 12)

and issues relating to patient preferences,

> *"If she was refusing to tolerate that then we would just have to go for straight forward bandaging"*(GN1 Scenario15).

Although pain is rarely verbalised as a specific cue within the rationale for choosing a treatment, it is sometimes mentioned as a factor that needs addressing alongside the judgement as to what sort of compression, if any should be used.

> *"and I'd probably opt to put her in four layer bandaging, get her pain sorted out as well. It might be infected."* (GN3 Scenario 9)

A verbal rationale which includes more than one or two factors is relatively rare but sometimes occurs,

> *"I don't think I will compress other bandaging until I've gone a bit further into it I think, the reason being, his pain, his infection, his leg cramps and I just don't like the look of it."*(GN2 Scenario 4).

However, one issue that frequently recurs is the nurse participants' consideration of the risk and safety issues associated with their choice of treatment.

> *"It's safe for full compression,"*(GN1 Scenario 8)
>
> *"I'm reasonably confident because I'm going to do no harm."*
>
> (GN2 Scenario 1)
>
> *"I might opt, I think I'd be cautious and just put her in something with no compression at the moment."* (GN 3 Scenario 8)

A strong awareness of the risks associated with high compression appears to underpin the nurses'' rationale for their choice of treatment. In Chapter 3, the literature search had identified 'patient safety' as a factor that impacted on clinical judgement for treatment but (as discussed in Chapter 5) the complex multi-faceted nature of assessing a patient's safety meant that it had not been possible to operationalise this factor in a meaningful way as a cue within the judgement analysis task. However, the think-aloud data suggests that 'patient safety' is an important cue when choosing whether or not to apply high compression.

Overall, it seems likely that the nurse participants used a heuristic to link a diagnosis of venous leg ulceration with high compression but then verbalised rationalisations based on other cues to explain why they were choosing to override the heuristic. Some of the cues mentioned in the rationales were those that had been operationalised within the Judgement task but 'patient safety' which had not been operationalised may also be of some importance when choosing whether or not to apply high compression.

8.6. Conclusion

This chapter has presented the results in relation to treatment. The Judgement Analysis data showed that the cue with the most importance when judging whether or not to use high compression was the diagnosis of the leg ulcer. However, the nurse participants attributed less importance to this cue than had been attributed in the ecology. The nurse participants regarded pain as the least important cue but this cue was the second most important cue in the ecology. The Think Aloud data and qualitative data from the exit page of the Judgement task showed that in addition to the cues which had been provided in the patient scenarios, the nurse participants sought additional information about the patients' pain, levels of mobility, dexterity or available assistance in relation to deciding whether to prescribe bandaging or hosiery and how those patients with a previous history of leg ulceration had achieved healing. The expert group would have liked more information about patients' pain, their ability to communicate, their mental capacity for making responsible and appropriate decisions should their bandaging become uncomfortable or painful and the appearance and size of the whole affected limb.

In relation to the accuracy of community nurses' choices of whether to not to apply high compression, expertise as defined by job role and education did appear to have an impact. The Judgement Analysis data showed that although there was a medium to large correlation in relation to the accuracy of the overall nurses' treatment judgements, the TVSNs were more accurate in their treatment judgements and had a higher level of ability in using evidence based information. Nurses with more education were also more accurate in their treatment choices than those with less education. The nurses were under-confident for the judgements in which they indicated a lower level of confidence but were fairly appropriately confident for the judgements in which they indicated a higher level of confidence. Generally, the TVSNs were more confident than the GCNs.

The Think Aloud data suggested that the rationale for the treatment choices was rarely fully verbalised and the nurse participants appeared to often draw on a heuristic that linked the diagnosis of venous leg ulceration with high compression to reach their treatment choices. However, when a rationale for a treatment judgement was verbalised, it often focussed on other cues (in particular, issues relating to 'patient safety') to explain why the heuristic was being over ridden.

These chapters have presented the results about:

- How the information cues for diagnosing leg ulceration are used by community nurses,
- The accuracy of the community nurses' diagnostic judgements for venous leg ulceration
- How the information cues for making treatment choices about high compression therapy for treating venous leg ulceration are used by community nurses,
- The accuracy of the community nurses treatment choices in relation to the provision of high compression for venous leg ulceration,

- The impact of expertise on the diagnoses and treatment choices of community nurses,
- The cognitive processes used by community nurses when making diagnoses and treatment choices about venous leg ulceration.

The next chapter will discuss these results.

CHAPTER 9

DISCUSSION

This thesis set out to uncover how community nurses use the information available to them to make diagnoses and treatment choices about high compression therapy for patients with venous leg ulceration. In particular, it sought to evaluate the quality of their resulting diagnoses and treatment choices and to discover the possible impact of 'expertise'. The existing literature (as discussed in Chapter 2) suggests that the quality of nurses' diagnoses and treatment choices for these patients may be below the standard that is potentially achievable in practice, but there was very little robust research evidence to explain *how* nurses make these judgements and decisions.

9.1. The uncertainty of the clinical environment

Before considering the quality and process of the nurses' judgement and decision making, it is useful to consider the context within which these judgements and decisions are made. As discussed in Chapter 2, clinical judgement is often complex, because it is based on uncertain information and applied to widely varying clinical situations. Although evidence- based practice offers an approach to reducing uncertainty, the nature of clinical practice and the variability of individual patients means uncertainty will always exist within the environment in which judgements and decisions take place. Hammond defines irreducible uncertainty as, "uncertainty that cannot be reduced by *any* activity at the moment action is required" (Hammond, 1996a, p13). The levels of accuracy achieved in this thesis should be considered within the context of the irreducible clinical uncertainty surrounding venous leg ulceration.

The results of this thesis show evidence of considerable clinical uncertainty for the management of venous leg ulceration. In Judgement Analysis, the level of ecological predictability (Re) of a task indicates how predictable a judgement task is *given* the set of cues in the ecological model and is thus a good indicator of the level of accuracy that could (theoretically) be achieved in the simulated task (Stewart et al., 1997). In real (i.e. non-simulated or tightly controlled) judgement, perfectly predictable tasks where Re = 1.00 are impossible. Some research has used judgement tasks in which a 'correct'

judgement is entirely a function of the information presented to the judge and achieved perfect predictability (Yang, 2009). In this study the predictability/ Re of the 'ecology' (the model of how well the cues predicted 'expert' treatment choices which was the judgement criterion) for treatment was still high at 0.89. The predictability of the model for diagnosis was somewhat lower at 0.63 indicating the raised levels of uncertainty associated with the diagnostic task.

9.2. Accuracy in diagnosis and treatment

Judgement Analysis was used to explore how community nurses made diagnoses and treatment choices about managing venous leg ulceration. Judgement Analysis measures the quality of judgements by correlating nurses' judgements against an acceptable criterion or 'gold standard'. As discussed in Chapter 5, a definitive 'true' diagnosis or treatment choice against which a nurse participant's judgements can be measured to assess a level of 'accuracy' is unattainable for venous leg ulceration. Therefore, in this study, the 'truth' is the consensus judgements of a panel of community nurses with 'expertise' in leg ulcer management. The judgements of the consensus panel are likely to be (or at least are assumed to be) of high quality but perfection is improbable, (though comparing the quality of judgements against the benchmark of what an expert or reasonable person would have done is a well established technique in health and the law (Samanta and Samanta, 2003)). So when the word 'accuracy' is used to describe the community nurses' performance, it is important to remember that this refers to the level of agreement with the 'truth' which itself may be inaccurate. Similarly, the weighting of the cues in the ecology model is informed by the potentially imperfect judgements of the consensus panel. So, comparisons between the ecology lens models and the nurses' lens models cannot be regarded as absolutes but as the 'best' that can be reasonably achieved, given the inherent uncertainty in the task.

The results showed that using Cohen's definition of the relative strength of a correlation coefficient (Cohen, 1988) overall there were only 'medium' levels of agreement between the community nurses and the consensus panel in relation to both diagnosis and treatment choices. When considered within the context of clinical uncertainty indicated by the predictability of the ecology models, greater uncertainty was associated with the

diagnostic model. A priori, this greater uncertainty would be expected to be associated with greater variability amongst and between nurses and lower levels of 'accuracy' (the correlation between expert and nurse judgements) in the diagnostic task. However, this was not borne out as the levels of 'accuracy' achieved for diagnosis (Ra = 0.48) and treatment (Ra = 0.49) were very similar. Therefore, reduced predictability may be important in explaining the lower level of 'accuracy' in the diagnostic task but less important in explaining the level of the accuracy in the treatment task.

Reduced predictability can be due to the omission of relevant cues in the ecological model. In this study most of the cues that the literature search suggested were relevant for diagnosis of venous leg ulceration were operationalised within the scenarios. However, in lens modelling, the elements which fall outside the models are represented by 'unmodelled knowledge' parameters (C_1, C_2 and C_3) and in the diagnostic judgement model, one of the 'unmodelled knowledge' parameters (C_1) was relatively large. This suggests that, despite being based on the leg ulcer literature, the ecology diagnosis lens model did not capture some of the information that the nurses use to make their diagnostic judgements.

The qualitative data indicated that some nurse participants sought additional diagnostic cues. Some of these cues had been identified by the literature search but excluded because they were unavailable from the patient records or because they were difficult or impossible to operationalise within computerised patient scenarios (a limitation of this study which will be discussed later). However, some were newly identified cues such as details of how an ABPI assessment was carried out and the 'feel' of an ulcerated limb. It is possible that nurses use cues for diagnosis other than those identified by the literature.

If this information had been identified and included in the ecology diagnosis model, the predictability of this model might have been higher but presenting large volumes of cues may reduce the predictability of judgement models (Stewart et al., 1997). The literature review identified 36 cues relevant to diagnosis of venous leg ulceration. To achieve a higher level of representativeness, the scenarios presented all the actual cues present within each patient's case notes (although for the purpose of statistical analysis, these were analysed as six cue categories.) No scenario contained all 36 cues but there were usually quite a few more than the 7 ($\pm$ 2) cues discussed in Chapter 5 (p 80). The nurses were unlikely to attend to more than 10 cues but liable to vary as to which cues

they chose to attend to (Brehmer and Brehmer, 1988, Gigerenzer et al., 2002). However, more is not always better. Fast and frugal theory (see p 46) suggests that the principle of 'take the best, ignore the rest', which is based on prioritising the most relevant information rather than the volume of information, can lead to more accurate judgements (Gigerenzer and Goldstein, 1996). So, adding cues that the nurses thought were 'missing' might increase the 'noise' of the task which might distract attention from more relevant cues. Alternatively, since 'noise' is present in real life, it is possible that the judgement task in this thesis is over- simplified and thus inadequately representative.

Predictability is also adversely affected if the cues themselves are weakly related to the judgement criterion – i.e. unpredictable (Cooksey, 1996b). This was the case with some of the diagnostic judgement task cues (as discussed in Chapter 5). For example, the measurement of ABPI is vulnerable to error (Vowden and Vowden, 2006) and some clinical signs of venous hypertension (such as inflammation on the lower leg) can signify one or more different diagnoses (such as infection and/or venous dermatitis) (Doughty et al., 2000). The nurse participants reported that in clinical practice they would have sought more detailed information about how the ABPI assessment had been carried out, which suggests the nurses' awareness of the uncertainty associated with ABPI assessment. However, it is worth noting that none of these cues are associated with positive diagnosis of venous leg ulceration but to exclude other possible diagnoses (such as arterial insufficiency). The cues identified by the literature exclude any form of assessment of venous function (apart from the presence of varicosities) but venous function might be one of the most powerful diagnostic pieces of information. Since a gold standard diagnosis for venous leg ulceration does not exist, the uncertainty of the ecological model for diagnosis may be appropriate uncertainty since, at present, it may not be possible to achieve a perfectively predictive ecological model for diagnostic judgement.

The higher level of predictability of the treatment ecology model was not mirrored by higher levels of accuracy for treatment choices and the treatment lens model statistics for unmodelled knowledge were very low, so it is unlikely that the predictability of the treatment model could be notably improved by the inclusion of additional cues. One possible explanation for the nurses' levels of treatment choice accuracy is that they may

not have used the available cues in the best possible way. Although diagnosis was the most important cue in both the nurses' and ecology treatment models, it was given less weight in the nurses' treatment choices. Pain was also given less weight than in the ecology model and the nurses' levels of cognitive control indicated that they did this consistently thus inappropriately embedding these flaws within their treatment choices. There may also have been some misunderstanding about the patients' willingness to wear compression. At the beginning of the task the nurses had been informed that "None of the following patients has refused compression therapy but some are reluctant to have compression". It is possible that some nurses misinterpreted 'reluctance' as 'refusal, which might explain why the nurse gave double the importance to this cue than was given in the ecology.

There was also some evidence that the same issues affected the accuracy of the diagnostic judgements. The ABPI cue was the most important cue for diagnosis in both the ecology lens model and the nurses' model but the nurses gave less weight to other cues that had been given higher weight in the ecology lens model (such as medical history and appearance) and higher weight to cues that had been given less weight (such as pain and age). Again, they assigned similar levels of importance to the same cue across the task thus compounding these judgement errors. Overall, the nurses used an ABPI of below 0.8 to predict a diagnosis of ulceration associated with significant arterial disease which is in line with the leg ulcer literature but individual nurses varied widely and sometimes the cue may not have been interpreted appropriately. This has important clinical consequences since poor assessment and inadequate treatment, can lead to serious adverse outcomes such as amputation (Callam et al., 1987).

The confidence levels of the nurses may have also impacted on their accuracy. Under-confidence can carry high costs in terms of clinical decision making. For example, when choosing a treatment for leg ulceration, under-confidence may lead a clinician to make a more cautious (or incorrect) treatment choice. This may lead to withholding a treatment perceived as potentially dangerous (such as high compression) but which when used appropriately is likely to be highly beneficial. The nurses were under-confident (less confident than was justified) about diagnosis at confidence levels below 45% and about treatment at confidence levels below 80%. So, if a nurse was aware of the risk of applying high compression to an arterially compromised leg but lacked

confidence in the accuracy of their diagnosis, they might prefer to withhold high compression. This might partly explain the levels of treatment accuracy that were achieved. At higher levels of confidence the nurses were over-confident but for treatment, at confidence levels above 80%, they were only slightly over-confident or their confidence matched their accuracy. However, for diagnosis at confidence levels over 45% they were considerably more confident than was justified.

Over-confidence and under- confidence are both features of clinical decision making (Soll, 1996, Petrusic and Baranski, 2002). Over-confidence may generate unwanted costs. There is evidence to suggest that when people have high confidence in a judgement they are less motivated to seek more information to confirm or deny that judgement (Kruglankski et al., 1991). This may be particularly true in a situation such as leg ulceration where feedback on accuracy (such as the correct diagnosis) is not easily available. Over-confident nurses may also be less motivated to use information support systems such as practice guidelines (Friedman et al., 2005). Under-confidence may motivate nurses with low confidence to seek the advice of clinicians with more expertise or to consult sources of information such as text books or the online data sources (Thompson et al., 2004). Under-confidence may thus act as a driver for seeking additional evidence-based information which may bring benefits. However, if humans are the preferred source of information (Thompson et al., 2004) but the human 'experts' (such as the tissue viability specialist nurses) are themselves under-confident this may increase the risk of inappropriately conservative diagnoses and treatment judgements and increase referral rates to other clinicians which may increase costs to health care providers and patients.

In this study, the under-confidence and over-confidence for diagnosis is particularly worrying since diagnosis is such an important cue for the treatment choice. Furthermore, the nurses' ability to discriminate between their correct and incorrect judgements for both the diagnostic and treatment judgement was low and overall the nurses had poor insight into their ability to make accurate diagnoses and treatment choices. Under-confident nurses are likely to make over-cautious diagnoses, while over-confident nurses may make insufficiently informed diagnoses. The diagnostic errors resulting from both over and under confidence will be transferred into the treatment choice increasing the risk of treatment errors. The literature suggests that

experienced nurses have a tendency towards over-confidence (Baumann et al., 1991, Hamers et al., 1997, Yang, 2009) but in this study, nearly all the nurse participants had high levels of experience but displayed both over-confidence and under-confidence in their diagnoses and treatment choices.

The confidence calibration statistics also supported the possibility that the diagnosis and judgement tasks were difficult. Previous studies have found low levels of calibration to be linked with increased task difficulty (Petrusic and Baranski, 1997, Yang, 2009) and in this study there was only a moderate level of calibration between the nurses' own assessment of their confidence in their own judgement and the probability of that judgement being correct. There was a lower level of calibration for the diagnostic task than for the treatment task, which suggests that the diagnosis task might be more difficult than the treatment task.

The simulated nature of the judgement task may have impacted on the validity of the study. Some nurses suggested that they were less confident because the simulated presentation of the judgement task prevented them gathering the full range of information they would seek in actual clinical practice. They also felt unable to use their usual sources of support (such as colleagues' opinions) even though they had been advised that they could do so. It is likely that this perception of restricted information gathering will have had an effect on performance. The nurses seemed to suggest that they would derive 'confidence' from the ability to collect more information (even if, as discussed above, the literature suggests that more information may contribute little to the judgement). The nurses also reported self-consciousness since their decisions would be studied and evaluated. Another study, which also used a simulated approach to examine the judgements of critical care nurses in recognising acute deterioration in critically ill patients, but in which the judgement model had perfect predictability, found evidence of over-confidence rather than under-confidence (Yang, 2009). Critical care nurses may be different to community nurses, but it is possible that the lower confidence levels in this thesis may not be entirely due to the simulated presentation of the judgement task. However, as this comparison is based on two simulated judgement tasks rather than a comparison with nurses making diagnoses in a natural practice setting, this cannot be regarded as robust evidence.

9.3. Expertise and accuracy

This thesis also sought to explore the impact of 'expertise' on accuracy. Job role and level of education were used as proxy indicators for expertise, and the lens statistics suggested that job role did impact on accuracy, as the diagnoses of the tissue viability specialist nurses were a little more accurate than those of the generalist community nurses. The most important cue in the treatment judgement was diagnosis, so it was expected that this pattern would be mirrored in the treatment accuracy. However, although the tissue viability specialist nurses were slightly more accurate in choosing high compression treatment than the generalist community nurses, the difference was smaller.

Possible reasons why the tissue viability specialist nurses were more accurate than the generalist community nurses could include issues related to experience. In this study, nearly all the tissue viability specialist nurses and generalist community nurses had similar high levels of years of nursing experience in caring for leg ulcers, so it was not possible to assess whether higher levels of experience in general contributed to higher levels of accuracy. However, on average, the tissue viability specialist nurses did spend almost twice as many hours per week caring for patients with leg ulcers, compared to the generalist community nurses. As discussed in Chapter 3, there is only limited evidence to suggest that increased experience is linked with improved patient outcomes, but there is evidence to suggest that more hours of deliberate practice is related to higher levels of performance (Ericsson et al., 1993). Employment as a tissue viability specialist nurse might allow more 'deliberate practice' which leads to higher levels of performance (Ericsson, 2004). Nonetheless, it is also possible that individual generalist community nurses, who may not have a 'tissue viability specialist nurse' job title, but who also seek out education and 'deliberate practice' (for example, by developing an in-house leg ulcer clinic or by being responsible for the all the patients with leg ulcers in the caseload or GP practice) may also achieve higher levels of accuracy.

Although the tissue viability specialist nurses were more highly educated than the generalist community nurses there was no evidence to suggest an interaction effect between job role and education for either the diagnosis or treatment task. So, in line with the current uncertainty as to whether academic education contributes to the development of expertise as measured by better patient outcomes (as discussed in

Chapter 3) education alone was not related to the level of accuracy of diagnosis or treatment. It has been suggested that expert performance might be related to the innate personality attributes of individuals who constantly seek to improve and develop their knowledge and skills in a particular field (Ericsson et al., 2007). The high correlation between academic attainment and tissue viability specialist nursing may be more closely related to academic study being one of the activities that tissue viability specialist nurses undertake as a requirement of their role, or because they have an innate desire to seek knowledge and information, rather than education itself being a cause of expertise.

There may be other reasons for the tissue viability specialist nurses' higher levels of achievement. Evidence suggests that when a task is itself unpredictable, then judges themselves become less predictable in their judgement behaviour (Stewart et al., 1997). The cognitive control of the tissue viability specialist nurses indicated that they were better at overcoming the imperfect predictability of the diagnostic judgement task. However, they were no better at this for treatment, so this alone does not explain why they were a little more accurate. The tissue viability specialist nurses were better than the generalist community nurses at managing the information which the literature had identified as being relevant to diagnosis and treatment, but for the remainder of the lens statistics, there was either no difference or very small differences between the tissue viability specialist nurses and the generalist community nurses. Therefore, the differences in the lens model statistics shed little light on why the tissue viability specialist nurses were generally more accurate. The components of expert performance remain elusive, but the results of this thesis suggest that nurses who are designated expert by their job title (i.e. the tissue viability specialist nurses) on average are slightly more accurate in their diagnoses and treatment judgements.

Correct judgements benefit patients by promoting the quality of life improvements associated with improved healing, but may also benefit health care providers in terms of cost savings. However, it is important to note that the better performance of the tissue viability specialist nurses may not automatically translate into more cost-effective care. The assessment of possible cost benefits would also need to incorporate factors such as any differences in the salary costs and the time spent on care between tissue viability specialist nurses and generalist nurses. So, although tissue viability specialist nurses are more accurate, it is possible that this increased accuracy may not translate into

meaningful cost benefits. Furthermore, in order to have a population of nurses that includes specialists, it is also necessary to have novices and those who are developing their knowledge and skills since nurses are not born with expertise and specialist knowledge. Restricting certain aspects of practice to only specialist nurses potentially increases the risk of descending into a downward spiral, where generalists get worse as they get less practice.

9.4. The range of cognitive approaches

Although the Think Aloud study used a reasonable number of patient scenarios, the data was collected from only three generalist nurse participants and one group of tissue viability specialist nurses, so this discussion is cautiously developed. However, it does provide a theoretically and empirically grounded starting point for further research. The results suggest that these nurses drew on a range of cognitive approaches for making diagnostic and treatment judgements. Nurses who had previously been verbalising what appeared to be a stream of consciousness, made silent, swift judgements which were not apparently preceded by conscious cognition which might be interpreted as evidence of intuitive cognition (Benner, 1984). There was also evidence of analytical cognition (which has been characterised as slow, sequential and retraceable) particularly for diagnosis (Cooksey, 1996d). The Think Aloud did not require the nurses to offer a coherent account of their cognitive processes, but it did allow an opportunity for this and it was noticeable that when a nurse had shown evidence of intuitive cognition, this was often followed by verbalised analytical rationalisation for their intuitive choice. This may have been a Hawthorne effect prompted by the nurses' awareness that they were being observed and recorded, so may not accurately portray natural practice. Alternatively, since most nurses work as part of a team, such post-hoc rationalisation may occur in natural practice as a means of exploring and checking judgements with a peer group. Several of the nurse participants commented at the end of the Judgement Task that they discussed patient management with their colleagues, so the habit of team working may have been perceived within the conditions of the task. The post-hoc rationalisation may have been verbalisation of analytical cognition playing a supervisory role to intuitive judgements as in dual process theory where analytical,

System 2 thinking checks and balances intuitive, System 1 thinking (see Chapter 3 p 61).

Pattern matching (see Chapter 3 p 44) also seemed evident when nurses' judgements appeared to follow information processing theory with pattern recognition against 'schema' held in the memory. In all cases, the nurse participants initially verbally gathered information before considering possible diagnoses. There were differences in the initial order in which the nurse participants moved through the judgement making process, but these cues were then often checked against these possible diagnoses before making a final judgement. A previous study which examined the judgement and decision making of nurse practitioners who had been educated to deliver clinical care in a manner similar to the 'medical model' found evidence of information processing cognition in their decision making (Offredy, 2002). None of the nurses who took part in the Think Aloud in this thesis were nurse practitioners, but some had undertaken nurse prescribing and non-medical prescribing education which has been informed by medical education (Luker et al., 1998) and this may have influenced their cognitive approaches.

There was also evidence to suggest the use of heuristics, particularly in relation to the ABPI reading and the use of high compression where the nurses used a 'rule of thumb' to link a diagnosis of uncomplicated venous leg ulceration with a treatment choice of compression. Although the qualitative data from the expert consensus group was not think-aloud data, it is worth noting that the group also explicitly used the same heuristic. Heuristics offer a way of managing 'bounded rationality' due to perceptions of time limits and memory capacity but are prone to biases which can lead to sub-optimal judgements (Tversky and Kahneman, 1974). It is possible that *imaginability* bias (when the clinician can imagine extreme risks such as amputation (Tversky and Kahneman, 1974)) may have emphasised the risks associated with high compression applied to arterially impaired legs, which might have contributed to the nurses' under-confidence and over-cautious approaches.

Therefore, the results of this study do not support the previous studies (discussed in Chapter 3 p 42) which found nurses' decision making for wound care to be mainly intuitive (Hallett et al., 2000, Lauri and Salantera, 2002). The results of this study also support the doubts discussed in Chapter 3 (p 39-41) about the links between intuition and expertise. From a relative perspective, the nurse participants in this study were

'experts' by virtue of their seniority and experience. However, from an absolute perspective their overall performance did not indicate 'expert' performance despite their use of intuitive cognition.

Cognitive Continuum theory, which suggests that judgement making will contain varying proportions of both intuition and analysis, and that judgement tasks can be ordered along a continuum, according to the mode of judgement they are likely to induce (Cooksey, 1996d, Paley et al., 2007) offers a better explanation for the cognition observed in this study. The nurses used a range of cognitive approaches along the Cognitive Continuum and adapted and switched their approach depending on the challenges of the task. Intuition may have been induced by the complex structure of the Judgement task (Cooksey, 1996f). For example, a large number of cues were presented simultaneously (although the diagnosis cue for the treatment choice was only present once the nurse had made the diagnosis) and it was likely that some cues were redundant since some cues would have predicted each other. An evidence-based, validated, accurate organising principle for combining the evidence, such as a decision making algorithm, did not exist and although all the nurse participants were 'familiar' with diagnosing and treating leg ulcers, leg ulcer management is only one of many areas of responsibility for community nurses. Assessing accuracy in leg ulcer management is difficult in the clinical setting, since even when an ulcer is treated successfully, healing is slow and prolonged and the patient is likely to experience discomfort. This lack of immediate feedback may have led to flawed perceptions of accuracy increasing the likelihood of intuitive cognition (Cooksey, 1996f). The cue data was presented in its natural form but may have been mainly perceived as continuous data (such as the ABPI reading and 'how red does the leg look?') and many of the cues were presented in pictorial form (through the wound photo) which again is more likely to induce intuitive cognition. Furthermore, the availability of 'peer-aided' judgement was limited since the judgement task was undertaken as a solo activity which again is more likely to induce intuitive cognition (Hamm, 1988, Cooksey, 1996f).

Cognitive Continuum theorists have proposed that pattern recognition (which is linked with heuristics and bias theory) can influence the form of cognition applied to a task (Cooksey, 1996f). Pattern recognition involves the application of prior learning and experience and is more likely when a Judgement Task is perceptually rich, conceptually

organised or requires the judge to offer a coherent account. In this study, the nurse participants had prior learning and experience of managing venous leg ulceration. Also, the judgement task was perceptually rich in offering the nurses visual information in the form of the wound photo and information that the literature suggested was appropriate, especially information about the ABPI reading. However, although information was conceptually organised in that the nurses were offered a brief clinical history, they were required to assimilate this organised history alongside the less coherently organised visual information within the photograph which might explain why the ABPI / compression heuristic rule was not applied more frequently and more rigorously.

Cognitive Continuum theory proposes that movement along the cognitive continuum is a function of time (measured in minutes rather than days / months etc) (Cooksey, 1996f). Although the informants were advised that they could take as long as they needed, the nurses' awareness of the size of the judgement task appeared to lead them to adopt a time-limited approach which emulated their clinical practice and which is more likely to induce intuition. No data was gathered to indicate whether this perception altered from scenario to scenario, but this perception appeared to apply across the whole task. Therefore, it was not possible to assess whether the perception of availability of time had impacted on whether a nurse used more intuitive or more analytical cognition.

The limited sampling of the Think Aloud restricts the trustworthiness and transferability of the results, but in this study there was no evidence to suggest that intuition was solely the preserve of experts or that intuitive judgements might be linked with higher levels of accuracy; both intuitive and analytical cognitive approaches appeared to be used by a range of nurses in a range of situations. However, the observed range of cognitive approaches fell within the cognitive middle ground of quasi-rationality between intuition and analysis (Cooksey, 1996f). This may have been induced by the restricted task characteristics (as suggested by the imperfect predictability of the ecology lens models) and the lack of relevant robust research information and decision-making tools for leg ulceration. Nurses' preference for human sources of information over research-based information as noted in Chapter 3 may have also been a factor. For example, the nurses who stated that they would have sought the advice of the tissue viability nurse and those who reported that they discussed their judgements with their colleagues were operating at the peer-aided judgment mode of enquiry level (Mode 5 – see p49) of the

Cognitive Continuum. It is possible that this preference might be partly explained by the shortage of research-based information but be totally appropriate given the nature of the task.

Empirical evidence suggests that decisions made using intuitive cognition are less accurate than decisions made using simple linear models (Hastie and Dawes, 2001). Analytic cognition is more accurate and precise, but this precision is more fragile in that a single mistake in a carefully designed analytical approach can have unwanted consequences (Hammond, 1996c). For example, the results of this study suggest that the diagnostic judgement should give most importance to the ABPI result, followed by the patient's medical history and the appearance of the ulcer. If however, the ABPI suggests a diagnosis of venous leg ulceration but has been incorrectly measured, an analytical approach would still give most weight to this cue even if 'less important' cues suggested a different diagnosis. This would be likely to result in an incorrect diagnosis when a more intuitive approach might have resulted in a more correct diagnosis.

Despite these risks Hammond proposed that cognition should be, "as analytical as it can be and as intuitive as it must be" (Hammond, 1996b, p151). If the levels of accuracy that are being achieved through quasi-rational cognitive approaches are satisfactory, then Simon's argument that "the best is the enemy of the good" (Simon, 1991, p361) argues against the need to adopt a more analytical approach. If however, the levels of accuracy that are being achieved are judged to be in need of improvement, then opportunities for inducing more analytical approaches should be explored. For this to happen though, nurses would need access to information such appropriate decision making tools or good quality research data as well as the ability and time to make sense of such information.

Conclusions about community nurses' judgement and decision making for venous leg ulceration

The nurses studied in this thesis were only moderately accurate in their diagnostic and treatment judgements for leg ulceration, but this may be at least partly explained by the clinical uncertainty shown to be inherent within the environment of venous leg ulceration judgement and decision making, specifically:

- uncertainty about which cues should be considered
- uncertainty about how much weight should be given to particular cues
- consistency in which an inappropriate level of importance was attributed to certain cues.

In particular, the clinical environment of the diagnosis task is associated with considerable uncertainty, especially as to whether all the appropriate cues are identified and whether nurses are giving certain cues their appropriate weight. There is less uncertainty in the treatment task, so the nurses' reduced levels of accuracy for treatment are more likely to be related to them attributing too little importance to the diagnosis cue and too much importance to the other cues, compared to the ecology model. The diagnosis is the most important cue for the treatment choice. The most important cue for the diagnosis is the ABPI but there is considerable uncertainty relating to this particular cue. This uncertainty might explain the nurses' under-confidence about their diagnoses and treatment judgements (despite their relatively high levels of clinical experience) which might translate into an over-cautious approach to offering high compression.

The tissue viability specialist nurses were a little more accurate in their judgements. The reasons for this are unclear but it could be because their job role allows them more opportunity for 'deliberate practice' (Ericsson, 2004) in caring for patients with leg ulcers.

The cognitive reasoning observed in community nurses' management of venous leg ulceration is quasi-rational, but towards the intuitive end of the Cognitive Continuum. This form of cognitive reasoning is in accordance with the type of cognitive reasoning induced by the structure of the judgement task, but may contribute to reduced accuracy.

9.5. Strengths and weaknesses of the research design

9.5.1. Judgement Analysis

Judgement Analysis was chosen because it offered the best methodological approach available for both measuring the level of accuracy of the nurses' diagnostic judgements and treatment choices, and for capturing the complexity of how the cues which the literature identified as relevant, were used to reach these judgements (see Chapter 4). Judgement Analysis methodology requires the participants and the judgement task to resemble the natural clinical situation as closely as possible. The judgement task was designed with the aim of achieving the highest possible level of representativeness, but inevitably there were some areas where this was difficult to achieve.

The strengths of the judgement task design included the use of detailed and relevant actual patient clinical data and random sampling in selecting the patient records. However, a large proportion of the patient records were sampled from a population of patients with sloughy venous or mixed aetiology ulcers who had volunteered to take part in a randomised controlled trial. Although this was a pragmatic randomised controlled trial and thus more likely to reflect a reasonably wide range of patients with leg ulceration, these patients may not be entirely representative of the overall venous and mixed aetiology leg ulcer population.

Stratified random sampling, based on the recorded ulcer diagnosis, was used to select the patient records which populated the scenarios. This diagnosis had been made by the nurse who recruited the patient to the trial, was based on the trial inclusion criteria (which was based on the leg ulcer literature) and was likely to involve both the clinician caring for the patient and the research nurse supporting the recruitment of that patient. Despite this, some diagnoses may have been incorrect. However, the proportions of the diagnoses of the sample were very close to the estimated UK proportions of diagnoses and those made by the expert panel group for the ecology, so the total patient scenario sample is likely to adequately represent the leg ulcer diagnostic proportions in the UK population.

Some compromises had to be made when using the data to populate the scenarios. Some cues that had been identified by the literature search were excluded because they were difficult or impossible to operationalise using computerised patient scenarios (such as

odour, the feel of a limb or 'patient safety') or because they were unavailable from the patient records (which implies that such information is not currently thought essential for diagnosis or is not recorded). The omission of cues relating to cost will limit the generalisability of this thesis to healthcare settings which have different health funding arrangements to that of the UK.

The Venus II data had recorded patients' medication along with the reasons for the prescription of the medication. This indicated the patient's current medical status, but patients may have had diagnoses or past medical history for which they were not receiving medication. The manipulation of data relating to the patient's preferences in relation to bandaging also compromised representativeness, as this data was artificially contrived rather than naturally occurring.

As discussed earlier in this chapter, whilst it is likely that the most important cues were included in the scenarios, it is also possible that there are further sub-cues related to the ABPI cue and the pain cue which have relevance for diagnosis which were not measured in this thesis. The potential relevance of these sub-cues is not currently clear and further research is required to clearly identify these and establish their level of importance in diagnostic judgements.

The coding of the ABPI results may be open to criticism. Statistical requirements meant that the ABPI results were presented to the nurse judges in their original form as a ratio, but these readings were re-coded as dichotomous dependent variables for the logistic regression. As there is a lack of robust evidence to inform the definitions of these criteria, this coding was based on the inclusion criteria for two large randomised controlled trials of interventions for venous leg ulceration which only included ulcers with an ABPI of $\geq$0.8-<1.2 (Iglesias et al., 2004, Dumville et al., 2012). National clinical guidelines confirm that $\geq$ 0.8 should be regarded as the lower limit indicating adequate arterial supply to the lower leg but at present there is no agreed upper limit (Royal College of Nursing, 2006). Therefore, it could be argued that the upper limit of $\leq$1.2 in this thesis is too restrictive.

Presenting the scenarios online using photography and written scenarios allowed the presentation of identical information to each of the nurse participants. Wound photography is used in certain aspects of wound care (often in a research context) but

this approach did not mirror how leg ulcer assessment is usually conducted within the natural setting. Although each scenario included a good quality photograph and a detailed scenario that contained all the information that was recorded in the patient's record, many of the nurse participants commented that conducting an assessment through a computer programme felt different to undertaking a face to face assessment. As discussed in Chapter 5, the computerised approach was the best available option (given the trade off between ecological validity/representativeness and the requirement to capture many nurses making multiple judgements) but in trading these two factors, the use of computers may have had an impact on the participants' judgments and decisions; thus, the results should be considered in light of this potential limitation. The increasing interest in telemedicine within healthcare in general and wound care in particular, may make computerised scenarios less of a limitation in future wound care research that uses Judgement Analysis methodology (Binder et al., 2007, The Kings Fund, 2012).

There were also issues with the quality of the photographs. Two of the patient data records which were originally sampled could not be used because the quality of the photographs was too poor: substitute records were randomly sampled to replace these. Despite this, several of the participants made valid comments that the colour of the photograph may not have adequately represented the actual colour of the limb. It was also noted that in some photographs it was possible to see indentations from the removed dressings or bandages, which the nurse participants noted may have influenced their decisions. However, in the natural setting, a nurse will be aware of what has been removed from the patient's leg prior to conducting an assessment, so this may have increased the representativeness of the scenario.

As discussed earlier in this chapter, Judgement Analysis requires the identification of an acceptable 'gold standard' judgement to form the ecological model against which the nurses' judgements are correlated. The use of an 'expert panel' to provide these judgements was a justifiable design decision but an imperfect solution. Although it had relevance to practice where expert judgments are a legitimate gold standard in the absence of alternatives, neither the nurses' lens' model statistics nor cue weightings can be regarded as definitive but as best possible estimates which may be flawed.

In Chapter 5, the nurse participant sample data included some of the individual judgement data generated by tissue viability nurses who later took part in the consensus meeting which generated the ecology data. There was no risk that this individual data could be affected by the consensus group discussion as this data was gathered before the consensus meeting. However, it was possible that including these nurses' individual judgements in the nurse participant sample might have inflated the mean levels of accuracy achieved. Therefore, the mean lens model statistics for achievement (R_a) for both the diagnostic and treatment judgements were recalculated omitting the data from those nurses who had participated in the expert consensus panel (Table 9.1 and Table 9.2).

Table X Diagnosis lens model statistics for achievement / accuracy (R_a)			
Participants	**Mean**	**SD**	**N**
All nurse participants	0.48	0.17	36
All nurse participants minus expert panel members	0.45	0.17	32
All GCNs	0.38	0.16	18
All TVSNs	0.57	0.13	18
All TVSNs minus expert panel members	0.55	0.13	14

Table 9.2 Treatment lens model statistics for achievement / accuracy (R_a)			
Participants	**Mean**	**SD**	**N**
All nurse participants	0.49	0.18	36
All nurse participants minus expert panel members	0.47	0.18	32
All GCNs	0.41	0.18	18
All TVSNs	0.57	0.14	18
All TVSNs minus expert panel members	0.55	0.14	14

Omitting the expert consensus group data from the analyses reduced the nurses' mean levels of accuracy for both the diagnostic and treatment judgements. The effect was seen for both the overall data and for the TVSNs but the reduction was too small to have any impact on the conclusions of the study.

The inclusion criteria meant that all the nurse judges were familiar with the task requirements, but the use of purposive sampling, rather than random sampling, resulted in a sample that may not adequately represent the nurse population who undertake assessment and treatment of leg ulceration (Bryman, 2001). Recruitment of sufficient generalist community nurse participants was difficult and upon enquiry, I was informed that this was because many of the nurses who had been encouraged by the local tissue viability specialist nurse had declined because they did not feel sufficiently confident about their own knowledge and skills in this clinical field. Most of the generalist community nurses who did participate in the study had a high level of seniority, autonomy and clinical experience, and were perceived by their peers as having advanced knowledge and skills in leg ulcer care. This may not be typical of generalist community nurses who are responsible for making diagnostic and treatment choices for patients with leg ulceration and so it is possible that the results for the generalist community nurses in this thesis may over-estimate the level of achievement of generalist community nurses. Furthermore, the generalist community nurses were only sampled from one geographical region in the UK. Therefore, the results for the generalist community nurses in this thesis may not accurately estimate the level of achievement of UK generalist community nurses in general and caution should be exercised when seeking to extrapolate these results to the wider population. However, the tissue viability specialist nurses were sampled from across the UK so although random sampling would have increased the generalisability for the results for this group of nurses, the results are likely to be more representative than for the generalist community nurses.

The sample size calculation for the nurse participants indicated that a sample of 38 nurses would be required to detect a medium to large effect size of (Ra/judgement achievement of 0.2) but it was only possible to recruit 36 nurses within the time constraints of the thesis. Future research should focus on validating the patterns observed in the thesis and the stability of the estimates derived from the judgement models. With regard to the sample size for the scenarios, the Judgement Analysis literature recommends using a ratio of 5-10 scenarios per cue (Cooksey, 1996c). However, a previous study which used the recommended 5 scenarios per cue found this proved insufficient for deriving stable logistic regression estimates in idiographic

analysis (Yang, 2009). The sample size for the scenarios which was based on Stewart's tables (Cooksey, 1996c) equated to a ratio of 18 scenarios per cue which gave stable logistic regression estimates and did not prove too burdensome for the nurse participants.

The manner in which the bandage choice options were offered to the nurse participants may also have over-simplified the judgement process. The nurse participants were offered a range of bandage choices which had been streamlined into generic groups, but a more representative approach would have been to ask the nurse participants to state their choice of bandaging, which would then have been classified against the different bandage types. However, this would have been more time-consuming for the nurse participants and would have required a high level of accuracy in naming of all components of the chosen bandage system and describing the method of application. The streamlined bandage choices still offered the complete range of compression types and since none of the nurse participants sought advice about this issue, it is likely that the categorisation was familiar and posed no problems.

A range of demographic data was gathered from the nurse participants but 'years of experience' and 'amount of time allocated' was collected as nominal data: ordinal data would have offered more statistical opportunities for analysis. It might also have been helpful to measure the level of the nurse participants' existing knowledge about leg ulceration before the judgement task was undertaken to provide another proxy indicator for 'expertise'.

Overall, the strengths of this thesis principally lie in its high level of representative design and adequate sample sizes. None of the weaknesses identified were of sufficient significance to invalidate the results of the Judgement Analysis but caution should be exercised in generalising the results of this Judgement Analysis to the UK community nursing population.

9.5.2. Think Aloud Techniques

Think Aloud techniques were chosen to complement the Judgement Analysis approach as a methodological approach capable of exploring the cognitive processes used by community nurses when making clinical judgements and decisions about venous leg ulceration. Think Aloud techniques require certain circumstances to minimise the risk of altering the form of cognition (Ericsson and Simon, 1998).

The original sampling plan had been to collect think-aloud data from three generalist community nurses and three tissue viability specialist nurses in order to seek a sample which would provide rich and broad data from a range of perspectives. However, due to time pressures, instead of recording the thinking-aloud of three individual tissue viability specialist nurses, I recorded the discussion of the expert consensus group. While this gave useful data about how these tissue viability specialist nurses used information to arrive at judgements and diagnoses, the data concerned group decision making rather than individual decision making. Therefore, this data could not be used to uncover the individual cognitive processes of community nurses when making judgements about diagnosis and treatment for leg ulceration.

The Think Aloud data of the generalist community nurses was gathered from a non-reactive environment, without the presence of people who would overhear expressed 'inner speech' but I was present as the researcher. While it was possible that my presence pushed the informant towards 'social speech' there was no evidence of this in the think-aloud transcripts. Other studies have found that Think Aloud offers a relatively robust technique that does not appear to affect performance (Aitken et al., 2011).

As in Judgement Analysis, the task that is being presented should be representative of the area of activity being examined (Ericsson and Simon, 1998). Although every effort was made to optimise representativeness of the judgement task, the requirements of the Judgement Analysis methodology demanded that the judgement task should be identical for each nurse participant, which necessitated the use of computer presentation. As discussed above, computer presentation reduced the ecological validity.

Evidence suggests that since nurses gather data from a number of sources including verbal reports, observation, prior knowledge and written reports, an ecologically valid

simulated task will also include information from a number of sources (Lamond et al., 1996b). The nurse participants were permitted to use data from other sources (such as consulting a formulary) but even when reminded of this during the think-aloud, none of the nurse participants chose to do this. In the comments opportunity at the end of the Judgement Task, several of the nurse participants commented that in real life practice they would have sought the opinions of colleagues: presumably the artificial setting inhibited this behaviour.

As noted in Chapter 5, it has been suggested that the addition of retrospective reporting techniques to concurrent reporting techniques may lead to richer data although evidence presented by Ericsson and Simon (1998) suggests that this is unnecessary. If retrospective data had been gathered immediately following the collection of concurrent data, it might have yielded even richer data and provided the opportunity to check for accuracy, which would have increased the validity of the data. However, as the case is not yet formally made that such approaches add to data collection, the lack of this mode of data collection in this study is not problematic.

A study which compared observation with think aloud techniques found that a combination of methods led to richer data, as the different techniques identified different judgement and decision tasks. The Think Aloud also dramatically increased the amount of behaviour that was captured compared to observational techniques (Aitken et al., 2011). In this thesis, Judgement Analysis was used rather than observational methods, but the Think Aloud did yield useful additional data which could not have been captured through Judgement Analysis alone.

Overall, the Think Aloud data contributed useful additional data although the small sample size limits the transferability of the results. However, the data that was gathered does provide some useful insight into the cognitive approaches that are used in the management of venous leg ulceration by community nurses.

9.6. Implications for clinical practice

Accuracy in diagnosis is important because misdiagnosis and consequential incorrect treatment choices are likely to have a significant impact in terms of healing rates, patients' quality of life, patient safety and healthcare costs. Inappropriate treatment has potentially serious implications for patients whose ulceration is due to causes other than venous insufficiency alone. Certain types of high compression can be useful for some conditions besides uncomplicated venous leg ulceration (such as lymphoedema (Lymphoedema Framework, 2006)) but patients who are misdiagnosed, but treated with high compression, may receive a treatment that is of no benefit, potentially harmful and sometimes dangerous. This study did not analyse treatment judgements in relation to different non-venous leg ulcer aetiologies, so it is not possible to assess what proportion of inaccurate treatment judgements in this study were likely to be unbeneficial, or even harmful, but the implications for misdiagnosis and incorrect treatment for venous leg ulceration can be considered in more detail.

Failing to offer high compression to a patient with uncomplicated venous leg ulceration may be perceived as less clinically risky than offering high compression to a patient with an arterially compromised leg. However, the reduced (or lack of healing) that is associated with inappropriate treatment of venous leg ulceration will still cause suffering for a patient in terms of ulcer-related symptoms and reduced quality of life, as well as incurring avoidable cost to the healthcare provider. In 2006, the estimated mean cost of an episode of venous leg ulcer treated with four layer bandaging was £1,549 of which £1,343 was related to nursing and medical time (Posnett and Franks, 2007). Trial data suggests that 70% of such patients will heal within 6 months and then only require minimal on-going care to prevent recurrence (Iglesias et al., 2004). Patients with uncomplicated venous leg ulceration who do not receive high compression are unlikely to heal to within six months (or even twelve months) but will still require similar levels of nursing and medical time. Therefore, when considering implications for clinical practice, it is important to recommend strategies which promote accuracy in diagnosis and treatment choices to optimise healing rates, improve patients' quality of life and promote cost-effectiveness.

When diagnosing leg ulceration, appropriate weight should be given to the known cues (particularly the ABPI and the medical history)

The diagnosis ecology lens model indicates that in community nursing the ABPI cue is the most important cue when diagnosing venous leg ulceration. The medical history cue was also of considerable importance and together these cues accounted for 79% of the total weight in the diagnosis ecology model but the nurses only gave these cues a total weight of 52%. Nurses should be encouraged to give these cues sufficient weight in their diagnostic judgements.

It is important to note that in current UK community nursing practice, no positive test for venous insufficiency is currently available and therefore diagnosis rests on excluding other possible diagnoses. An ABPI measurement above 0.8 is not a positive indicator of venous ulceration but rather an indicator of the likely absence of significant arterial disease. Although it has been argued that the ABPI should not be regarded as the "Holy Grail" of leg ulcer assessment (Vowden and Vowden, 2001) it does offer the best available cue for identifying leg ulceration complicated by significant arterial disease. Leg ulceration may have a multitude of aetiological causes other than venous or arterial insufficiency but such causes are relatively unusual. Therefore, a diagnostic 'judgement rule' which states that a leg ulcer with an ABPI of $\geq$0.8 is most likely to be due to venous insufficiency (unless there is evidence to suggest an alternative diagnosis) may be helpful in clinical practice. Assessment documentation which is designed to support this approach may be helpful.

The qualitative data suggested that there was particular uncertainty around measuring the ABPI. The current guidelines recommend that all patients with leg ulceration should be screened for arterial disease using Doppler assessment of ABPI by "staff who are trained to undertake this measure" (Royal College of Nursing, 2006). The guideline notes the unreliability of ABPI measurement by clinicians who have not received formal training and cites evidence that reliability can be considerably improved if clinicians are highly trained in this type of investigation. However, the expertise literature discussed in this thesis raises doubts about the effectiveness of education alone in developing expertise. It seems likely that the opportunity for 'deliberate practice' is more likely to lead to expertise so those with responsibility for Doppler assessment of ABPI are likely to develop expertise by not only having access to education but having the opportunity

for frequent practice of this procedure. Such opportunities are likely to be limited within generalist community nursing practice (such as within normal district nursing or practice nursing) due to the relative infrequency of opportunities for undertaking Doppler assessment of ABPI. Therefore, community nurses with responsibility for measuring ABPI should seek out frequent and regular opportunities to acquire and maintain adequate competence/ expertise, such as through participating in specialist leg ulcer clinics with high patient throughput.

When making treatment choices, appropriate weight should be given to the known cues (particularly the diagnosis cue)

According to the ecology lens mode, the diagnosis cue appears to be the most important cue in relation to the treatment choice accounting for 63% of the weight in the decision but there is evidence to suggest that nurses only gave this cue 45% of the total weight. High compression is unlikely to cause harm to a leg with an adequate arterial supply. Therefore, a treatment 'decision rule' that states that all ulcers with an adequate arterial supply (i.e. an ABPI of $\geq$0.8) should initially be treated with high compression insufficiency (unless there is evidence to suggest a diagnosis other than venous insufficiency) may be helpful in promoting healing in patients with leg ulceration.

Tissue viability specialist nurses were more accurate than generalist community nurses but this difference may not translate into meaningful cost benefits for healthcare providers.

As discussed previously, tissue viability specialist nurse specialists were more accurate in both diagnosis and choosing high compression, but it is not clear whether this difference would translate into meaningful cost-effectiveness for healthcare providers. The data from this study suggests that tissue viability specialist nurses fulfil a useful role in supporting generalist community nurses in managing leg ulceration. However, it is unclear whether increasing the role of such nurses in managing venous leg ulceration would improve care, as the assessment of possible cost effectiveness would also need to incorporate factors such as any differences in the salary costs and the time spent on care

between tissue viability specialist nurses and generalist nurses. Since the differences in this study were small, this seems unlikely but more analysis of the data from this study and other studies is required to model the likely impact of such service development.

9.7. Implications for research

Research to identify the relevant cues for diagnosis

The ecology lens model for diagnosis had relatively low predictability and a relatively large ‘‘unmodelled knowledge’ parameter (C_1) which suggests that it did not capture some of the information that the nurses use to make their diagnostic judgements. For example, although the ABPI cue appears to be the most important cue in the diagnostic judgement, the qualitative data suggested that some more nurses used the sounds of the procedure and how the procedure was conducted to gain information that informed their diagnostic judgements. Furthermore, the statistical requirements of this study limited exploration into how the ABPI measurement was interpreted and the complexity associated with the information for this cue is still unclear.

At present, it seems likely that rather than formally assessing venous insufficiency, nurses diagnose venous leg ulceration by excluding other possible diagnoses and then assessing whether the treatment for venous leg ulceration achieves healing. Chapter 2 noted the paucity of robust research based knowledge to support the diagnosis of venous leg ulceration which may explain this approach. If this information could be identified and included in the ecology diagnosis model, the predictability of the model may improve. Research is required to both identify the additional cues that nurses currently use and to evaluate the accuracy in terms of sensitivity and specificity of cues thought to be relevant for diagnosis of venous leg ulceration.

Research to identify whether the proposed diagnostic and treatment decision rules improve accuracy

A diagnostic rule and a treatment decision rule are proposed as possible means of increasing the accuracy of diagnostic judgements and treatment choices for patients with leg ulceration. Further research is required to measure the sensitivity and specificity of such decision rules to assess their ability to correctly identify both uncomplicated venous leg ulcers and ulcers due to causes other than uncomplicated venous leg ulceration (i.e. to detect true positives and false positives). If such rules are shown to be sufficiently sensitive and specific, then a trial should be conducted to assess the effectiveness of such rules in promoting accuracy in diagnosis and treatment choices by community nurses.

Examining the impact on the participants' performance of judgement modelling

With regard to the implications for research design for future Judgement Analysis studies, a much larger number of scenarios than the standard recommendation for Judgement Analysis research was used and succeeded in deriving stable logistic regression estimates for the idiographic analysis. It is possible that a smaller number might achieve the same levels of stability and be less burdensome for the participants and this might be explored in further research.

Computerised simulation with photography offered the most representative approach possible, as leg ulcer physical simulators do not currently exist. However, if physical simulation had been possible, it is likely that physical simulation of the same number of scenarios would have presented a more demanding task for the participants than computerised simulation. The large scenario sample was only possible because the scenarios were presented in manner that did not prove too demanding for the nurse participants. However, a previous Judgement Analysis study which compared physical simulation to paper simulation, found evidence that nurses performed less well in physical simulations than in paper simulations (Yang, 2009). Therefore, it is possible that the computerised simulations of this thesis may have an unknown impact on the nurse participants' performance. In future Judgement Analysis studies where physical simulation is possible, consideration should be given to the trade off between presenting

sufficient scenarios to achieve stable logistic regression estimates and the demands on the participants associated with the manner in which the scenarios are presented.

Increasing representativeness of modelling without impacting on cue selection

In order to more closely reflect the reality of clinical practice, the nurse participants were presented with a much larger number of cues than the 7 (±) cues recommended for Judgement Analysis research (Cooksey, 1996d). As discussed in Chapter 5 some Judgement Analysis studies which have also ignored this recommendation found that even when large numbers of cues were available, the participants typically used fewer than 10 cues suggesting that it is more about what cues are included than how many. The results of this thesis support these findings. It seems likely that increasing the number of cues that are presented to the clinicians does not radically alter the number of cues actually used to make a judgement (i.e. Miller's 7 (±)). Inclusion of all the information that naturally occurs when a patient presents for assessment, increases the representativeness of the judgement task and does not appear to impact on normal cue selection. Therefore, future Judgement Analysis research should not limit the cues presented to participants to 7 (±) but aim to present all information that would usually be present in as naturalistic way as possible.

9.8. Conclusion

This thesis has argued that the environment in which community nurses are required to practice is uncertain, something which may explain their cautious behaviour and under-confidence. The models for diagnostic judgment and treatment choices for venous leg ulceration set out in this thesis provide a starting point for developing robust strategies for supporting judgement and decision making by these nurses. ABPI cue was an important but under-weighted cue in diagnosis and the diagnosis cue is similarly an important but under-weighted cue in treatment choice. Teaching nurses the value of ABPI may result in higher quality judgement and decision making. Decision rules have been proposed to support nurses' judgement and decision making but the sensitivity and specificity of these rules will need to be evaluated in future research.

The key test of any theory is its falsification (Popper, 1963) and this requires a fair test. Prior to this thesis no models existed against which clinical judgement and decision making for venous leg ulceration could be assessed. The research presented in this thesis offers the following foundations for developing theory in judgement for venous leg ulceration:

- that diagnostic judgement and treatment judgements models exist and can be tested,
- that levels of judgement accuracy achieved by community nurses vary and have scope for improvement,
- that tissue viability specialist nurses compared to generalist community nurses exhibited higher levels of accuracy in both diagnosis and treatment.

This thesis also offers support for the existing theoretical propositions that education alone is not directly linked with superior clinical performance, but that 'deliberate practice' may be linked with superior clinical performance.

The thesis does not support the theoretical proposition that expert performance is *de facto* linked with intuitive cognition since a range of cognitive approaches were apparent.

The thesis is innovative, in that it is the first judgement analysis study to examine tissue viability nursing and leg ulceration in particular, and it is the first judgement analysis study to examine community nursing. It is also the first study to examine the impact of expertise on the management of leg ulceration and to use quantitative calibration approaches to examine community nurses' confidence calibration performance. Furthermore, it is the first judgement analysis study in nursing which has used clinical photography to increase representativeness and to demonstrate that stable logistic regression estimates can be derived through using computerised simulation with photography to enable the presentation of large numbers of scenario.

The main contribution of this thesis is that it has exposed the complexity of the clinical environment in which community nurses are required to manage patients with venous leg ulceration. While this provides a context within which to understand the levels of accuracy that were achieved and the under-confidence of the nurses, more importantly it

provides a framework for developing strategies to improve accuracy. Such strategies will require investigation to assess their potential usefulness but they offer the possibility of more clinically and cost effective care for patients with venous leg ulcers.

APPENDIX A: Ethical Approval from University Of York

THE UNIVERSITY of York

Department of
Health Sciences

c/o Department of Philosophy
Heslington
York YO10 5DD

Telephone (01904) 433253
Fax (01904) 321383
E-mail smh12@york.ac.uk

Dr Stephen Holland

www.york.ac.uk/healthsciences

22 October 2009

Mrs U Adderley
University of York
Department of Health Sciences
Heslington
York
YO10 5DD

Dear Una

Re: **Community nurses' decision making for managing venous leg ulceration**

Thank you for your letter detailing the changes you have made to your protocol in response to the HSRGC's comments on your application. I am happy to confirm that you have addressed in full the issues raised and give Chair's action for the research to proceed.

If you make any changes to your research study at a later date, you may need to resubmit your proposal to the committee. If you have any questions regarding the committee's decision, then please contact me.

Yours sincerely

S. Holland

Stephen Holland (Dr)

Chair : HSRGC

APPENDIX B: Ethical Approval from York Research Ethics Committee

York Research Ethics Committee
Learning and Research Centre
York Hospital
Wigginton Road
York
Y031 8HE

Telephone: 01904 725125
Facsimile: 01904 731297

17 November 2009

Mrs Una J Adderley
Team Leader - Specialist Nurse SWR
Malton Hospital
Middlecave Road
Malton, York
YO17 7NG

Dear Mrs Adderley

Study Title:	**Judgement and decision making of community nurses in relation to the management of venous leg ulceration**
REC reference number:	**09/H1311/86**

Thank you for your letter of 09 November 2009, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair, who would like to thank you for your prompt and accurate reply.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk. *Where the only involvement of the NHS organisation is as a Participant Identification Centre, management permission for research is not required but the R&D office should be notified of the study. Guidance should be sought from the R&D office where necessary.*

Sponsors are not required to notify the Committee of approvals from host organisations.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*	
REC application	22055/71015/ 1/255	22 October 2009	
Protocol		22 October 2009	
Letter from University of York Ethics Committee		22 October 2009	
Supervisors CV - Professor Carl Thompson			
Participant Information Sheet: Patient	2	09 November 2009	
Participant Consent Form: Patient	2	09 November 2009	
Letter of invitation to participant	V2 Nurse Participants	09 November 2009	
Flow Chart of Patient Recruitment	2	09 November 2009	
Data Extraction Form	2	09 November 2009	
Information on how to take Consent	2	09 November 2009	
Response to Request for Further Information		09 November 2009	
Participant Information Sheet: Nurse	2	09 November 2009	
Participant Consent Form: Nurse	2	09 November 2009	
V2 Introduction letter to Nurses seeking patients	2	09 November 2009	

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Service website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

09/H1311/86	**Please quote this number on all correspondence**

Yours sincerely

Mrs Alison Booth

Chair

APPENDIX C: Research Governance Approval from York

NHS permission letter (Non-CTIMP) R&D/T01

York Hospitals NHS
NHS Foundation Trust

R&D Unit reference: NYY-P01524

North and East Yorkshire Alliance R&D Unit

Mrs Una Adderley
Specialist Nurse
Malton Hospital
Middlecave Road
Malton YO17 7NG

Main Office: Learning and Research Centre
York Hospitals NHS Foundation Trust
York
YO31 8HE

Tel: (01904) 726996
Fax: (01904) 731297

www.northyorksresearch.nhs.uk

20th January 2010

Dear Mrs Adderley

NHS Permission to undertake a research study

Trust: North Yorkshire and York PCT
Study Title: Judgement and decision making of community nurses in relation to the management of venous leg ulceration

Thank you for submitting details of this study for NHS Permission from the above-named Trust, which is a member of the North and East Yorkshire R&D Alliance.

I confirm that the study has NHS Permission and can now begin in the Trust.

Please note that the study must be conducted in accordance with the approved protocol, the Department of Health Research Governance Framework for Health and Social Care and any applicable legislation.

Please check that you are aware of the sponsor's Standard Operating Procedures that are applicable to this study. If your study is sponsored by the Trust, please refer to the Standard Operating Procedures published on the Unit's website www.northyorksresearch.nhs.uk. These should also be used as a default for externally sponsored studies where the sponsor does not have its own procedure or where there are gaps in the sponsor's procedure due to local circumstances.

Please ensure that you notify me if there are any amendments to the study or when the study has ended and send me details of any publications that result from it.

May I wish you every success with the study.

Yours sincerely

Caroline Mozley
Head of Research and Development
On behalf of North Yorkshire and York PCT

The R&D Service for: East Riding of Yorkshire Primary Care Trust
Hull Teaching Primary Care Trust
Scarborough and N. E. Yorks Health Care Trust
Harrogate and District NHS Foundation Trust
North Yorkshire and York Primary Care Trust
York Hospital NHS Foundation Trust

APPENDIX D: Research Governance Approval re Sussex Community NHS Trust

NHS

Sussex NHS Research Consortium

Research Consortium Office
Worthing Hospital
Lyndhurst Road
Worthing
West Sussex
BN11 2DH

Tel: 01903 285027
Fax: 01903 209884
www.sxrc.nhs.uk

Mrs. Una Adderley
Team Leader - Specialist Nurses
North Yorkshire and York Community and
Mental Health Services
Malton Hospital
Middlecave Road
Malton
YO17 7NG

02/02/2012

Dear Mrs. Adderley,

Our ID: 1475/NOCI/2012
TITLE: Judgement and decision making of community nurses in relation to the management of venous leg ulceration.

Thank you for your application to the Sussex NHS Research Consortium for research governance approval of the above named study.

I am pleased to inform you that the study has been approved, and so may proceed. This approval is valid in the following Organisations:

- **Sussex Community NHS Trust**

The final list of documents reviewed and approved is as follows:

- IRAS NHS R&D form (unsigned and undated, received 04/01/2012: submission code 22055/79054/14/690)
- NHS Site-Specific Information Form (signed and dated 30/01/2012: submission code 22055/274469/6/558/139515/230738)
- Protocol (no version control, undated, received 03/01/2012)
- Nurse Participant Information Sheet (version 3, dated 18/01/2011)
- Nurse Participants Consent Form (no version control, undated, received 03/01/2012)
- CV for Una Adderley (signed and dated 12/12/2011)
- Letter from the University of York confirming compliance with HSRGC (signed and dated 22/10/2009)
- York REC approval letter (unsigned and dated 17/11/2009)
- York REC amendment 2 approval letter (signed and dated 23/02/2011)
- IRAS Notice of amendment Form (unsigned and undated, received 19/01/2012: submission code 22055/181236/13/447/5088)
- Letter from Una Adderley with clarifications (unsigned and undated, received 16/01/2012)

Your research governance approval is valid providing you comply with the conditions set out below:

1. You commence your research within one year of the date of this letter. If you do not begin your work within this time, you will be required to resubmit your application.
2. You notify the Consortium Office should you deviate or make changes to the approved

POSITIVE ABOUT DISABLED PEOPLE

SMOKING FREE ZONE

CSP047282

APPENDIX E: Information Sheet – North East Yorkshire Patients

THE UNIVERSITY of York

The Department Of Health Sciences

Please read this document carefully.

You are being invited to take part in a research study which will form the basis of a PhD that is being undertaken at the University of York.

Slow healing wounds on the lower leg are common and can be very distressing. Deciding on the best way to treat these wounds can be difficult and complicated. This study is to find out how nurses decide what is wrong with a wound and how to treat it.

One way to examine decision making is to present nurses with a series of clinical 'cases' (which include photos of the wounds) which are drawn from real life patient care and ask them to tell us what they would do for each case. Clinical 'cases' are more realistic when they come from real life patient information. The information that you gave when your nurse first assessed your wound would provide ideal information for these clinical 'cases'.

If you were to agree that your information could be used for this study then I would ask your nurse to collect the following information from your nursing notes:

- Your age
- Your sex
- Your level of mobility
- Your preferences (if any) with regard to bandaging
- Whether you require any assistance with the activities of daily living
- Your history of any problems with your veins or arteries
- Where your wound is (or was, if it has already healed)
- What your skin looks like around the wound
- What your leg looks like
- What your wound looks like
- Your ‘Doppler’ reading (when your nurse measured your blood pressure in your arm and your leg).
- What type of wound you have
- The level of pain you experience from the wound on your leg

I would then turn this information into a short ‘clinical story’. Your real name would not be used in this story. I would use a pretend name to protect your privacy. This clinical story (along with the photo that was taken when you first saw your nurse about your wound) would then be added to a collection of other patients’ clinical stories and photos to form a survey. I will ask nurses who have agreed to take part in the study to look at these clinical stories and photos and decide what type of wound each patient has and what treatment they would offer.

Nurses will complete this survey by computer by using the internet. Only registered nurses who have agreed to take part in this research and who have been given permission to see the survey will view it – no-one else will. I will carefully check that the nurses who agree to take part in the study are genuine community nurses and that they understand that your information must be treated as confidential information. Once the nurses taking part in this study have completed the survey I will collect their answers and remove the survey from the internet.

If you agree to allow your information to be used in this study, you will not be required to take any action other than to sign the attached consent form and give it to your nurse. Your nurse will take a photocopy to give to you and post the original to me. Your nurse will then collect the information from your nursing notes and pass that information and a copy of your wound photo to me.

Why do the study?

Making clinical decisions about leg ulcer care is complex and difficult. It is hoped that the results of this study will help nurses who make decisions about how to treat patients with wounds on their legs which are slow to heal.

Can I change my mind later?

Participation in this study is entirely voluntary. You can change your mind at any time. Your future care and treatment will not be

influenced by your decision to take part or not. If you do agree to take part in this study and decide at a later time to withdraw then you are free to do so at any time without influencing your future care or treatment.

What do I do now?

If you are willing for your information to be included in this study, please sign the enclosed consent form and pass it to your nurse who will return it to me. I will arrange for a copy of your signed consent form to be posted back to you.

Where can I get more information about the study?

If you do not understand anything on this information sheet or would like further information please contact me on the telephone number below.

Una Adderley 01653 604704

Tissue Viability Nurse / PhD student 07881 624687

E mail: una.adderley@nhs.net

North Yorkshire and York Community and Mental Health Services /

Department of Health Sciences, University of York

Thank you for taking the time to read this information sheet

APPENDIX F: Patient Consent Form

THE UNIVERSITY of York

The Department Of

Health Sciences

A study exploring the judgments and decisions of community nurses regarding the clinical management of venous leg ulceration.

Researcher: Una Adderley

Please initial box

1. **I confirm that I have read and understood the information sheet dated ……. for the above study and have had the opportunity to ask questions.** ☐
2. **I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.** ☐
3. **I give permission for my nurse to provide the researcher with information from my leg ulcer assessment record (including the photo of the wound on my leg.)** ☐
4. **I give permission for that information (including the photo of the wound on my leg) to be made available on the internet only to nurses participating in this research study.** ☐

I agree to take part in the above study.

……	……	……
Name of participant	**Date**	**Signature**
……	……..	……
Name of person taking consent	**Date**	**Signature**

If, at the end of this study, you would like a copy of the study results please tick this box. ☐

APPENDIX G: Patient Data Retrieval Form

THE UNIVERSITY of York

The Department Of

Health Sciences

Name				
ID No	*Please leave blank*			
Age		**Sex**		
Mobility	*e.g. Walks independently, walks with a frame, chair bound etc*			
Patient Preferences	*e.g. Not keen on bandaging, refuses bandaging, has no preferences etc*			
Patient Safety	*e.g. ability to summon help,*			
History of venous disease *(please tick all that apply)*		Varicose veins		
		Previous VLU		
		Phlebitis		
		Trauma in relevant leg (such as surgery, fracture or trauma)		
History of arterial disease *(please tick all that apply)*		Heart disease		
		Stroke		
		TIA		
		Diabetes		
		Peripheral vascular disease		
		Cigarette smoking		
		Rheumatoid arthritis		
		Night cramps		
		Rest pain in leg		
		Intermittent claudication		
Position of ulcer				
Pain	*Please ask the patient the place a cross on the line to indicate how intense the pain they have experienced ranging from no pain to the worst pain imaginable.* Question How intense has the pain been from your leg ulcer(s) in the past 24 hours? No pain Worst pain imaginable └──────────────────────────────────────┘			
Appearance of leg *(please tick all that apply)*		Hair loss		
		Taut shiny skin		
		Gangrenous toes / tissue necrosis in lower foot		
		Oedema		
		Dependent rubor		
		Pale or blue feet		
ABPI (Doppler)				
Diagnosis *(Please tick one)*		Venous		Arterial
		Mixed (Venous/Arterial)		Other
Contact Details of Nurse				
Name		Phone No,		

APPENDIX H: Example of a Patient Scenario

THE UNIVERSITY of York

Exit this survey

Part 2 - The Leg Ulcer Survey 27.05.11

Default Section

2%

Patient 1.

Mr Matlock is an 80 year old man. He has hypertension and is a cigarette smoker. This is his first leg ulcer. A recent ABPI of the ulcerated leg was 0.57 and Mr Matlock has scored his pain at 1. He is willing to wear compression bandaging, if appropriate.

***1. What type of leg ulcer is this?**

- Venous
- Mixed (Venous with arterial insufficiency)
- Arterial
- Unknown other

***2. On a scale of 1 to 10 (where '1' = "not confident at all" and '10' is "very confident") how confident are you that your diagnosis is correct?**

	1	2	3	4	5	6	7	8	9	10
.	○	○	○	○	○	○	○	○	○	○

***3. What is the MOST appropriate form of bandaging or hosiery for this patient to promote healing?**

- 4-LAYER BANDAGING applied at recommended stretch
- SHORT STRETCH BANDAGING applied at recommended stretch
- ELASTIC 2-LAYER COMPRESSION BANDAGING (e.g.K-Two,Coban) applied at recommended stretch
- 'REDUCED' COMPRESSION BANDAGING (e.g. 4-layer, short stretch or 2-layer bandaging reduced either by applying less stretch or by omitting one or more bandage layers)
- 40mmHg COMPRESSION HOSIERY(40mmHg at the ankle)
- OTHER COMPRESSION HOSIERY (less than 40 mmHg at the ankle)
- OTHER BANDAGING OR HOSIERY WITH MINIMAL OR NO COMPRESSION
- NO BANDAGE OR HOSIERY (i.e. dressing only)

***4. On a scale of 1 to 10 (where '1' = "not confident at all" and '10' is "very confident") how confident are you that your treatment decision is the best possible treatment for this patient?**

	1	2	3	4	5	6	7	8	9	10
.	○	○	○	○	○	○	○	○	○	○

Prev Next

APPENDIX I. Nurse Participant Information Sheet

THE UNIVERSITY of York

The Department of Health Sciences

Nurse Participant Information Sheet

A study exploring the judgments and decisions of community nurses regarding the clinical management of venous leg ulceration.

You are being invited to take part in a research study which will form the basis of a PhD dissertation. Before you decide whether or not to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask me if there is anything that is not clear or if you would like more information (my contact details are at the end of this sheet).

Whether or not you take part is entirely voluntary. If you decide to do so, you will be given this information sheet to keep together with a copy of the consent form which you will be asked to sign. You will remain free to withdraw at any time, without giving a reason.

Background to the study

Nurses make clinical judgements and decisions about leg ulceration that includes diagnosis and choosing treatment. Leg ulceration is a complicated clinical area. More information about how nurses make these judgements and decisions would enable us to develop better educational programmes around caring for patients with leg ulcers.

Why have you been approached?

The study is seeking a range of community nurses who are currently treating or have recently treated patients with venous leg ulceration.

What would you be required to do?

If you agree to participate in this study you will be asked to complete an online survey. The survey consists of 110 short clinical scenarios based on real patients. You will be asked to make a clinical judgement about the diagnosis and treatment for each of these scenarios. The aim of this study is to capture 'real life' clinical judgements and decisions: your answers will not be marked as 'right' or 'wrong'.

The survey can be completed at work or at home (providing you have internet access). The survey can be completed in one session or several smaller sessions but must be completed within one month of receiving your identification number and password. You will be able to contact me by telephone to seek advice about any technical queries about the website but I will not be able to give any clinical advice about the clinical scenarios. If you would like to see an example of the scenarios and questions please go to:

https://www.surveymonkey.com/s/UAdderleyExampleSurvey

(Please note that these example scenarios are fictitious).

If you agree to participate, please complete and sign the attached consent form and post it back to me in the attached stamped addressed envelope.

I will contact you by telephone and /or e mail to provide you with:

- a unique identification number,
- a password, and
- the e mail address of the website which carries the survey that you will be required to complete.

You will then be able to access the website and complete a short questionnaire about your level of expertise regarding leg ulcer care. This will take you around 10 minutes.

I will then contact you and either:

- Give you the second password to access the full survey, or
- Ask you to participate in the 'think-aloud' part of the study. This would involve me joining you for the first 30 minutes of you completing the survey in order to audiotape you 'thinking-aloud' as you undertake the survey. We would require a quiet place with internet access. After the first 30 minutes, I would leave you to complete the remainder of the survey alone, at your convenience.

What are the possible disadvantages and benefits of taking part?

Participation in this study may take up to four hours in time. If you chose to participate, your assistance will be greatly appreciated and the information gained from this study will be used to inform future research and educational developments. In addition, to compensate you for your time and inconvenience, a £20 Marks and Spencer voucher will be sent to you upon receipt of the completed survey.

Confidentiality

All information which is collected about you during the course of the study will be kept strictly confidential. The audiotapes will be regarded as confidential material and securely stored. Any information about you will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The results will be held in the University of York Library under the "Dissertations" section. If requested, I will send you a summary of the findings when the study is completed

Review and supervision of the study

This study has been reviewed and given approval by York Research Ethics Committee. The study is being supervised by the Department of Health Sciences at the University of York.

Contact for Further Information

If you require further information, please contact:

Una Adderley – Senior Lecturer – Research Methods

c/o Department of Health and Social Care

Room 1.15 – Constantine Building

Teesside University

Middlesbrough TS1 3BA E mail: u.adderley@tees.ac.uk

APPENDIX J. Nurse Participant Consent Form

THE UNIVERSITY of York

The Department of

Health Sciences

CONSENT FORM

Nurse Participants

A study exploring the judgments and decisions of community nurses regarding the clinical management of venous leg ulceration.

Researcher: Una Adderley **Please initial box**

1. I confirm that I have read and understood the information sheet dated 18.01.11 for the above study and have had the opportunity to ask questions.	
2. I confirm that I am either currently treating patients with leg ulceration or have treated at least two patients with leg ulceration within the last three months.	
3. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.	
4. I understand that the patient scenarios I will see should be treated as confidential information.	
5. If required, I give permission for the researcher to use audiotaping to record my 'Think Aloud' data while completing the computer simulated clinical scenarios.	

I agree to take part in the above study.

……. …… ……

Name of participant Date Signature

……. …….. ……

Name of person taking consent Date Signature

List of Abbreviations

ABPI	Ankle Brachial Pressure Index
CEST	Cognitive Experiential Self Theory
CI	Confidence Interval
EEG	Electroencephalogram
GCN	Generalist Community Nurse
IPC	Intermittent Pneumatic Pressure
LME	Lens Model Equation
LREC	Local Research Ethics Committee
MRI	Magnetic Resonance Imaging
NHS	National Health Service
NYY	North Yorkshire and York
NHS R & D Programme	National Health Service Research and Development Programme
PCT	Primary Care Trust
RR	Relative Risk
S1	System 1
S2	System 2
SD	Standard Deviation
TA	Think Aloud
TVSN	Tissue Viability Specialist Nurse
VAS	Visual Analogue Scale
VIF	Variance Inflation Factor

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