THE ROLE OF A NURSE-LED VASCULAR RISK REDUCTION CLINIC IN DIABETES CARE

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FOR THE DEGREE OF

MASTER OF SCIENCE BY RESEARCH

AT

DUBLIN CITY UNIVERSITY

2008

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Dedicated to

My husband Liam and my late mum Miriam, for their never ending support and encouragement

ACKNOWLEDGEMENTS

There are many individuals who offered valuable assistance in the course of this research and preparation of the thesis, whom I sincerely thank.

I wish to thank Professor Chris Thompson, whose influence on my professional development has been constant. Also my thesis supervisor, Dr Pamela Gallagher for her support and without whom, I would not have succeeded with this thesis.

I would like to acknowledge the enormous contribution of colleagues and friends, in their support and encouragement, especially the staff in the Diabetes Day Centre.

I am particularly grateful to the patients who participated in this study and without whom the study would not have been possible.

Finally, I would like to thank Bristol-Myers Squibb who funded the study through an unrestricted grant and the Novo Nordisk UK Research Foundation, who funded a research course in the University of Roehampton.

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Background and Aims
Type 2 diabetes is characterised by excess vascular morbidity and mortality. Intensive vascular risk reduction in type 2 diabetes patients with microalbuminuria has been shown to significantly reduce future vascular events by 50%. The aim of this research was to determine whether an intensive, nurse-led clinic could achieve recommended vascular risk reduction targets in patients with type 2 diabetes compared with standard diabetes management. In addition, the study aimed to test the hypothesis that diabetes patients attending the vascular intervention clinic would have a clearer understanding of the relationship between diabetes and heart disease than those randomised to standard diabetic care.

Method
Part 1: Two hundred patients with type 2 diabetes were randomised to receive either intensive nurse-led or standard diabetes care in a one-year study.
Part 2: Following completion of the vascular risk intervention study, a questionnaire examining knowledge of vascular risk targets, was sent to patients who completed the study.

Results
94 patients in each group completed the study. The groups were matched for age and baseline HbA1c, blood pressure and lipid profiles. More patients in the intensive group achieved targets than in the standard group, systolic BP (<130 mmHg) (33.0% vs 12.1%, p 0.001), diastolic BP (<80 mmHg) (75.5% vs 40.2% (p 0.001), cholesterol (< 4.8 mmol/L) (84.8% vs 63.6% (p 0.003), LDL cholesterol (< 2.6 mmol/L) (73.4% vs 54.5% (p 0.007) and HbA1c (<6.5 %) (53.2% vs 32.9% (p 0.005).

There was a 75% response rate to the questionnaire. A surprisingly high number of patients did not know what their ideal blood pressure (67.2%), cholesterol (65.1%) or HbA1c (68.1%) should be, with no significant difference between the groups. However, a high percentage of patients were aware that heart disease (89.2%) and stroke disease (82.8%) were complications associated with diabetes, with no significant difference between the groups.

Conclusion: An intensive, nurse-led clinic is more successful in achieving vascular risk reduction targets than standard diabetes care. However, education programmes for patients with type 2 diabetes need to include information regarding vascular risk factors and their relationship to diabetes.

Chapter 1
Introduction

1.1 Introduction

Diabetes mellitus is a metabolic disorder characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both (World Health Organization (WHO) 1999).

1.2 The global prevalence of diabetes

The prevalence of diabetes is increasing, with an estimated 194 million people (5.1% of adult population) affected worldwide, a figure which the International Diabetes Federation (IDF) expect to reach 333 million (6.3% of adult population) by 2025 (IDF 2003). The WHO estimates that this number will increase to 366 million by 2030 (Wild et al 2004). These figures may significantly underestimate the extent of the problem, since up to 50% of the population with diabetes remain undiagnosed and therefore untreated (Gonzales et al 2003). Furthermore, the most striking demographic change in global terms will be the increase in the proportion of the population over 65 years of age (Wild et al 2004). It is estimated that by 2030 the number of people over 65 years of age with diabetes will be greater than 82 million in developing countries and 48 million in developed countries (Wild et al 2004). Campbell (2000) suggests that the number of patients with type 2 diabetes is increasing for a number of reasons, intensive screening campaigns and new diagnostic criteria with lower threshold values.

While there is a lack of epidemiological data regarding the prevalence of diabetes in Ireland, the WHO (2007) estimated that there were 86,000 cases of diabetes in the Republic of Ireland in 2000, with these numbers expected to rise to 157,000 by 2030.

Furthermore, the recent Ireland and Northern Ireland Population Health Observatory (INIsPHO) report (Institute of Public Health in Ireland 2006) suggests that 141,063 adults in the Republic of Ireland (4.7%), and 67,063 (5.4%) in Northern Ireland have diagnosed and undiagnosed diabetes. This is predicted to rise to 193,944 (5.6%) by 2015, a 37% increase. In Northern Ireland, 12.4% of all adults in the Asian population have diabetes, with estimated prevalence of 8.4% in "black" population and 5.4% in "white" population. Prevalence rates for ethnic minorities are not available to date in the Republic of Ireland. In both Northern Ireland and the Republic of Ireland, diabetes is more common amongst adult females than it is in males (6.3%: 4.5% in Northern Ireland and 5.4%: 4% in Republic of Ireland). Finally, the Cost of Treating Type 2 Diabetes in Ireland (CODEIRE) observational study suggested that although the true prevalence of diabetes is unknown, conservative estimates are 3.9% of the population with diagnosed diabetes and 6% if those with undiagnosed diabetes are included (Nolan et al 2006).

1.3 Overview of Type 2 diabetes

Type 2 diabetes is a progressive disease, characterised by a combination of insulin resistance and the gradual loss of insulin secretion from the pancreatic β cells (Feinglos and Bethel 2005, Campos 2007). Insulin resistance not only contributes to glucose intolerance but is also associated with hypertension, dyslipidaemia, endothelial dysfunction, increased serum clotting factors and platelet aggregation, which together contribute to the excessive cardiovascular and cerebrovascular risk associated with type 2 diabetes. Insulin deficiency leads to chronic hyperglycaemia and also affects carbohydrate, fat and protein metabolism (Vermeire et al 2006).

Type 2 diabetes mellitus is also an aggressive vascular disease (Campbell 2001) and management of diabetes encompasses a multi-factorial approach to risk management, rather than focusing on hyperglycaemia alone (Campbell 2001, Beckman et al 2002, Campos 2007). Gaede and Pedersen (2005) provide evidence that diabetes care should include management of cardiovascular risk factors, such as hypertension, dyslipidaemia, lack of physical activity, smoking and poor diet, which are commonly seen in patients with type 2 diabetes. Diabetes mellitus remains one of the most challenging diseases facing healthcare professionals and its increasing prevalence places a large burden on society, due to the progressive nature and the long-term

microvascular and macrovascular complications of chronic hyperglycaemia (Nathan 2002, Le Roith and Smith 2005, Nathan et al 2006). According to Betteridge (2004), the major challenge for clinicians who treat patients with type 2 diabetes and for the patients themselves is the prevention of macrovascular disease.

1.4 Complications of diabetes

Diabetes is characterised by both macrovascular (coronary artery disease, cerebrovascular disease or peripheral vascular disease) and microvascular (retinopathy, nephropathy or neuropathy) disease (Appendix 1). Both of these changes appear to commence at pre-diabetes levels of hyperglycaemia (Haffner 1998a, Rodriguez et al 1999). Harris et al (1992) suggest that there is a time gap from the onset of type 2 diabetes of four to seven years until clinical diagnosis. As a result, up to 50% of individuals with type 2 diabetes have evidence of complications at diagnosis (Manley et al 1990, United Kingdom Prospective Diabetes Study (UKPDS) V111 1991, Hypertension in Diabetes Study (HDS) 1993a). Kohner et al (1998) found that 37% of patients with newly diagnosed type 2 diabetes in the UKPDS had retinopathy at diagnosis. Diabetic retinopathy is the leading cause of new cases of blindness among adults (HDS 1993a, Fong et al 2003) and diabetic nephropathy is a leading cause of end-stage renal disease (Molitch et al 2003). Therefore early detection and treatment of complications is vital in patients with diabetes. The risk of microvascular complications increases with increasing plasma glucose concentration and the duration of diabetes. The risk of macrovascular disease depends on a number of factors, including age, gender, genetic factors, lifestyle (eg diet, exercise, smoking), in addition to hyperglycaemia (Goyder and Irwig 1998). The WHO (2006) suggests that approximately 2.9 million deaths per year are attributable to diabetes.

Cardiovascular disease is the most common cause of premature death among persons with type 2 diabetes (Ross 1999). This increased mortality is closely linked to three major risk factors: hypertension, dyslipidaemia and hyperglycaemia (Laakso 1999). Type 2 diabetes is recognised as a major risk factor for cardiovascular disease by the American Heart Association and the American Diabetes Association (ADA) (Grundy et al 1999). The development and progression of atherosclerosis and subsequent coronary heart disease (CHD) are influenced by both genetic and environmental

factors (Bertolini et al 1997, ADA 2004a). Cardiovascular diseases account for more than 70% of all deaths in patients with type 2 diabetes (Laakso and Lehto 1997, Muller 1998, IDF 2001, Feher 2004). Patients with diabetes without previous myocardial infarction have as high a risk of myocardial infarction as non-diabetic patients with previous myocardial infarction (Haffner et al 1998b). In patients with diabetes, coronary artery disease (CAD) may be associated with generalized endothelial dysfunction, in addition to abnormalities of small vessels. Frequently, diabetic patients have multiple coronary vessels involved by the time coronary disease is diagnosed or at the time of myocardial infarction (MI).

Complications have a substantial impact on the costs of managing type 2 diabetes (Williams et al 2002). For example, in the Cost of Diabetes in Europe – Type 2 (CODE-2) study, 72% of patients had at least one complication, with 24% having both microvascular and macrovascular complications, which increased the total cost of diabetes management by up to 3.5 times compared with those patients with no complications (Williams et al 2002). In addition to imposing a heavy burden on health care systems, serious micro and macrovascular complications of type 2 diabetes affect quality of life (QOL) of the patient (Jonsson 2002, Koopmanschap 2002, ADA 2003a). Consequently, prevention of complications not only benefits the patient in terms of improved quality of life, but could ultimately reduce overall healthcare expenditure (Williams et al 2002). Indeed, the use of a multidisciplinary team approach to diabetes care has been demonstrated to improve both glycaemic control and patient quality of life (UKPDS (33) 1998, Sadur et al 1999, Codispoti et al 2004).

1.5 Anti platelet therapy

Atherosclerosis and vascular thrombosis are major contributors to cardiovascular risk of patients with diabetes and platelets contribute to the risk of cardiovascular events (ADA 2004). There is increased production of thromboxane, a potent vasoconstrictor and platelet aggregant (ADA 2004). Because platelet aggregation plays an integral role in thrombus formation, treatment strategies have focused on using anti-platelet agents to prevent subsequent ischaemic events (Colwell and Nesto 2003). Aspirin blocks thromboxane synthesis and is therefore used as a prevention strategy to prevent cardiovascular disease in both diabetic and non-diabetic

individuals (ADA 2004). Clinical practise recommendations from the ADA (2004 - 2008) indicate that a secondary prevention strategy including anti-platelet agents should be adopted for patients with diabetes and evidence of macrovascular disease. In addition, there is evidence that low-dose enteric-coated Asprin therapy is recommended as a primary prevention strategy for people with diabetes who are at high risk for cardiovascular events (Colwell 1997).

1.6 Cost of diabetes

The WHO estimates that 2.5 to 15% of health care expenditure is attributable to diabetes-related illnesses (IDF 2006a). In the United States (US), the estimated cost of diabetes care had increased to $132 billion annually in medical expenditure and lost productivity (ADA 2003a). Cardiovascular disease was seen as the most costly complication of diabetes, accounting for more than $17.6 billion of the annual direct medical costs of diabetes in 2002 (ADA 2003a). Brown et al (1999) found that the per-person annual costs associated with Type 2 diabetes increased by more than 50% when cardiovascular complications occurred and by 360% when a major cardiovascular event occurred.

The CODE-2 study involving eight Western European countries was designed to study the economic issues relating to diabetes. It also had a number of secondary objectives, including evaluating the main components of cost, a review of current practice and an assessment of the impact of complications on cost (Massi-Benedetti 2002). Results indicated that the total direct medical costs of Type 2 diabetes for more than 10 million people with type 2 diabetes, in the eight European counties, was estimated at € 29 billion a year and the average yearly cost per patient was EUR 2834 per year. Of these costs, hospitalisations accounted for the greatest proportion (55%) of costs. Ambulatory costs, (which are defined as cost of visits to GP, diabetologists, other paramedicals, i.e. nurses and blood tests) amounted to 18% of overall direct healthcare costs. The overall cost of drug therapy was € 7.9 billion, which represented 27% of total healthcare costs. A breakdown of the drug costs indicated that expenditure on cardiovascular and lipid-lowering agents accounted for 42% of total drug costs with oral anti-diabetic agents accounting for only 13% and insulin 11% of costs (Jonsson 2002).

The CODEIRE study studied data on 701 patients attending four diabetes centres in Ireland to investigate the direct healthcare costs of managing type 2 diabetes (Nolan et al 2006). The results from the study estimated that the annual total direct costs associated with diabetes were € 377.2 million per annum (4.1% of total healthcare expenditure in Ireland). Hospitalizations accounted for approximately 48% of the overall costs, due to the fact that 60% of patients had developed complications.

There are many factors associated with the cost of diabetes. Direct costs to the patient include the cost of medical care and medications and direct cost to the healthcare system range from outpatient visits to hospitalization related to complications. Indirect costs for the patient include the psychosocial aspect of diabetes which can have the greatest impact on the lives of people with diabetes, whereas the indirect costs to society relate to loss of productivity as a result of disability, sickness or possibly premature death (IDF 2006a). Intensified blood pressure, lipid and glycaemic control increase costs but do improve health outcomes (The CDC Diabetes Cost-effectiveness Group 2002). The UKPDS showed that intensive blood glucose and tight blood pressure control in type 2 diabetes is cost effective and therefore should be integrated into management of all patients with type 2 diabetes (Clarke et al 2005).

1.7 Effect of multifactorial intervention on blood pressure, lipids and glycaemia and on morbidity and mortality

Type 2 diabetes is not just about blood glucose, but is a constellation of risk factors, hypertension, dyslipidaemia and glycaemia, which predispose to premature death. It must be noted that many interventional studies, from which guidelines have been developed, have concentrated on modifying a single risk factor in high-risk patients (Johansen and Birkenland 2003). However, in the Steno-2 study (Gaede et al 2003) 160 patients with type 2 diabetes and microalbuminuria were randomly assigned to either conventional or intensive treatment. Patients in the intensive group received a stepwise approach to behaviour modification and pharmacologic therapy. In addition, patients were offered individual consultations every third month during the eight-year study, which targeted hyperglycaemia, hypertension, dyslipidaemia and microalbuminuria, plus secondary prevention of cardiovascular disease with use of Aspirin. This target driven intensified multifactorial approach to treatment of type 2

diabetes reduced cardiovascular events by 53% and microvascular events by 58 – 63%. It also highlighted the difficulties of managing hyperglycaemia, with only 15% of patients with diabetes in the intensive group achieving the HbA1c target of < 6.5%, whereas 72% reached cholesterol target and 46% and 72% respectively reached systolic/diastolic blood pressure targets (Gaede et al 2003). This may be partly explained by a greater public awareness and acceptance of the general health benefits of lowering lipids and blood pressure, compared with awareness of good glycaemic control (Del Prato 2005). A more recent study by Johansen et al (2007) compared structured care combining lifestyle and pharmacological interventions versus standard care in 106 patients. They found that structured care improved several risk factors and reduced the estimated 10-year absolute risk for CHD in patients with Type 2 diabetes. Solomon (2003) however suggests that aggressive treatment of glycaemia and cardiovascular risk factors requires considerable effort on the part of physicians and patients. Gaede et al (2003) provide the best evidence to date of the extent of the benefit that can be obtained from multi-intervention.

The burden, financial and otherwise, of multi-drug therapy can be reduced by intensive attention to lifestyle modifications, including weight reduction, physical activity and moderate alcohol intake (Kaplan 2001). Current guidelines from the ADA (2008) emphasise the value of exercise, in contributing to weight loss and cardiovascular risk reduction. It has been suggested that weight loss is associated with 25% reduction in all-cause mortality and 28% reduction in CVD and diabetes mortality in overweight individuals (Williamson et al 2000). Jung (1997) suggested that a 10 kg weight loss may have a positive effect on glucose, lipids and blood pressure. Gregg et al (2003) studied 2896 adults with type 2 diabetes and showed that regular walking, 30 minutes per day, was associated with a 50% reduction in cardiovascular and total mortality. It is well known that smoking is the leading preventable cause of death and a major risk factor for cardiovascular disease. Therefore smoking cessation strategies are a high priority for primary and secondary cardiovascular disease prevention (Godley et al 2005). Pedersen and Gaede (2003) suggest that the challenge is to ensure that intensified, goal-orientated, multifactorial approach to the treatment of type 2 diabetes is adopted in daily practice.

1.8 Treatment guidelines and evidence based practice

Diabetes research has yielded substantial knowledge of effective management of the disease and the prevention of long-term complications. It is important, however, to accept that clinical trials often involve short-term follow up, with motivated patients and aggressive protocols for titrating medication doses at regular intervals (Grant et al 2004). Despite these factors, targets for glycaemia, lipids and blood pressure are attainable in only 50 – 70% of individuals in research studies, indicating that the targets may be impractical (Winocour 2002).

Based on the results from systematic studies, the ADA (2008) publishes updated guidelines annually which address glycaemia, blood pressure and lipid control (Appendix 2). However, although evidence-based practice guidelines for diabetes have been widely disseminated, many physicians fail to implement them (Larme and Pugh 2001). In addition, despite these well-accepted evidence-based guidelines for best practice, routine clinical management, particularly of blood pressure, fails to achieve targets (Berlowitz et al 1998, Berlowitz et al 2003; Borzecki et al 2003). It would appear that physicians are not therefore keeping up to date on the latest advances in diabetes treatment (Larme and Pugh 2001). All people with diabetes should have access to cost-effective evidence-based care, however in many parts of the world it is recognised that the implementation of standards of care is limited due to lack of resources (IDF 2005). Therefore, the IDF (2005) have developed an evidence-based global guideline for management of type 2 diabetes.

1.9 The importance of evidence-based medicine in routine clinical practice

Evidence based practice is the use of best available evidence to make clinical decisions that are most effective and beneficial for patients (Cope 2003). Healthcare delivery today demands research-based interventions. Patients have become more knowledgeable about their diseases as a result of the media and use of the internet and are therefore questioning healthcare providers. Physicians need to have a thorough understanding and awareness of the latest clinical practice guidelines and meta-analysis (Kennedy et al 2001). Vascular risk reduction targets for patients need to be individualised, as it is much easier for patients in the early stages of diabetes to reach a target blood pressure, however, the longer the duration of diabetes, the more

medication a patient will require to achieve targets (Burden and Burden 2001). Providing education and support to patients, as well as involving them in decision making, is vital in order that patients can take control of their condition and promote self-management (Del Prato 2005).

An important role of the diabetes care team is to ensure that glycaemic control remains the cornerstone of diabetes management. However, it is vital to aggressively manage hyperglycaemia, dyslipidaemia and hypertension with the same intensity, to obtain the best patient outcomes (Del Prato 2005). There is evidence that disease management programmes that aim at preventing complications – particularly CVD, are likely to significantly reduce the cost of managing complications associated with diabetes (Selby et al 1997).

1.10 Diabetes care in Ireland, United Kingdom and the United States

In the UK, there has been a major shift from secondary care to primary care (Pierce et al 2000, Burden and Burden 2001). According to Mason et al (2005), in England about one-half of people with diabetes are managed in hospitals with the other half managed in primary care. In the United States, primary care physicians provide diabetes care to 82% of patients with type 2 diabetes (DeWitt and Hirsch 2003). However, both primary and secondary care of diabetes fail with regard to managing to attain the recommended vascular risk targets in type 2 diabetes (Winocour 2002). Some primary care providers have suggested that the targets recommended by the UKPDS are impossible to achieve (Burden and Burden 2001). An audit carried out by Woodward et al (2001) of 500 patients attending hospital for management of type 2 diabetes and 500 being managed in the community, found that targets particularly with regard to glycaemic and blood pressure control, are not achieved in a high percentage of patients with type 2 diabetes. Results showed that 81% in the hospital and 72% in the community had HbA1c > 7%, both groups were similar for hypertension with 68% in the hospital and 66% in the community having blood pressure > 140/85 mmHg. However, of concern was that of those patients with hypertension, 45% and 49% respectively were not receiving treatment but of those receiving treatment, management in the hospital setting appeared more aggressive as

38% achieved a blood pressure < 140/85 compared with 25% in the community. In addition, lipid management in both groups was sub-optimal, with 56% in the hospital and 59% in the community having cholesterol level >5.2 mmol/L. It has been suggested, that nurse-led, target driven, vascular risk reduction clinics can effectively deliver vascular risk reduction (Denver et al 2003, New et al 2003). When patients are seen in nurse-led clinics, vascular risk protocols, which are pre-defined, are adhered to and medication titrated if patients are not achieving designated targets, whereas when patients are seen in outpatients or with their GP, medication is regularly not titrated at each visit.

The care provided for patients with type 2 diabetes in Ireland, is primarily hospital based. It is difficult to achieve vascular risk factor reduction targets due to the fact that in many centres, the majority of patients with type 2 diabetes are only reviewed on an annual basis in the outpatient clinic. In 2001, a closed loop audit of cardiovascular risk factors in Beaumont Hospital was undertaken to compare care from a previous audit carried out in 1997 (Sherlock et al 2006). The results showed that 51% of patients had hypertension, but this may be falsely low as the cut-off point in the audit at that time was 140/90. The audit demonstrated improved target cholesterol attainment, aspirin uptake and glycaemic control, but no improvement in reaching blood pressure targets, despite a significant increase in the number of patients on 3 or more anti-hypertensive agents.

There is no current shared care structure between primary and secondary care, in place in the setting of this study as a previous shared care programme (DISC) was discontinued due to lack of funding. It was felt that a new strategy was required to optimise the quality of the service provided to diabetic patients in our acute care setting. The aim of this research therefore, was to evaluate the effect of an intensive nurse-led, vascular risk factor intervention, on modifiable vascular risk factors, in patients with type 2 diabetes**.** In addition, the study aimed to test the hypothesis that diabetes patients attending the vascular intervention clinic would have a clearer understanding of the relationship between diabetes and heart disease than those randomised to standard diabetic care.

Chapter 2
Literature Review

Vascular risk factors and their effect on diabetes and patient knowledge of vascular risk factors

2.1 Introduction

Type 2 diabetes is not just about blood glucose but it is a constellation of risk factors, namely, hypertension, dyslipidaemia and glycaemic control, which predispose to premature death. Therefore, it is vital to address each of these risk factors, in order to reduce morbidity and mortality. Large randomized controlled trials have contributed to the body of evidence, indicating how important it is to manage blood pressure, lipids and glycaemic control aggressively, particularly in patients with type 2 diabetes.

This chapter focuses on available evidence, which illustrates the issues identified in the literature in relation to vascular risk factors and diabetes, and is structured under the following headings:-

- Vascular risk factors and their effect on patients with type 2 diabetes:-
  - hypertension;
  - dyslipidaemia and
  - glycaemic control
- Use of Nurse-led clinics in the management of hypertension and diabetes
- Patient education and empowerment in relation to diabetes
- Patient and healthcare professional knowledge of vascular risk factors relating to diabetes.

2.2 Background to evidence base on vascular risk factors and diabetes

The United Kingdom Prospective Diabetes Study (UKPDS (33) 1998) was the largest and longest trial involving patients with type 2 diabetes. A total of 5,102 patients with newly diagnosed type 2 diabetes were followed for a period of 10 years, to determine whether intensive treatment to lower glycaemic control would reduce micro and macrovascular complications. The study also compared different treatment regimes. In addition, patients who had hypertension were randomized into two groups to ascertain the benefits of lowering blood pressure. It has recently reported that the risk reductions provided by intensive therapy during the UKPDS were maintained at 5 years following completion of the study (University of Oxford 2005). The UKPDS and other key diabetes trials have demonstrated an inevitable increase in HbA1c and weight in the long term, whereas lipid and blood pressure targets can generally be achieved and sustained through poly-pharmacy (Lazarus et al 1997, UKPDS (38) 1998, Hansson et al 1998a).

It is vital to address the co-morbidities of type 2 diabetes which contribute to the many complications of this disease, therefore adopting a more holistic approach to disease management (Del Prado 2005). Serum cholesterol levels and systolic blood pressure, as well as cigarette smoking, have been identified as significant predictors of cardiovascular mortality, particularly in patients with diabetes (Stamler et al 1993). Several studies have demonstrated the benefits of managing hypertension and dyslipidaemia (UKPDS (38) 1998, Gaede et al 2003, Owen 2005). In addition, the Hypertension Optimal Treatment (HOT) study (Hansson et al 1998a) showed that the addition of Acetylsalicylic acid (Aspirin) reduced major cardiovascular events by 15% and myocardial infarction by 36%.

2.3 Hypertension

Hypertension is regarded as one of the main preventable causes of premature death in industrialized countries (Ezzati et al 2002). The definition of high blood pressure (hypertension) has changed over time and differs between guidelines proposed by expert groups (Wang and Vasan 2005). Hypertension is currently defined as a blood pressure $\geq$ 140 / 90 mmHg (Joint National Committee (JNC) 1984, ADA 2004a).

However, due to the vascular risks associated with hypertension and diabetes, the diagnostic criteria for diagnosis of hypertension in patients with diabetes, is > 130/80 mmHg (ADA 2002-2008). It is an extremely common condition, affecting approximately 20-60% of patients with diabetes (Arauz-Pacheco et al 2002, ADA 2004a). The WHO (2002) has estimated that high blood pressure is the third leading cause of death in the world. In Ireland 20% of deaths were due to cardiovascular disease in 2005 (Central Statistics Office 2006). Hypertension substantially increases the risk of both macrovascular and microvascular complications, including stroke, coronary artery disease, and peripheral vascular disease, retinopathy, nephropathy and possibly neuropathy (ADA 2004a). Approximately 35% of newly diagnosed and 70% of established type 2 diabetes patients can be classed as hypertensive (UKPDS 1990, UKPDS (38)1998). The prevalence of hypertension in this group of patients rises from 40% in those aged 45 years, to 60% in those aged 75 years (Prescott-Clarke and Primatesta 1997, Harris et al 1995, ADA 2004a).

2.3.1 Benefits of treating hypertension

Prior to 1996, most available data on hypertension and diabetes came from studies done in the general population, observing a subset of patients with diabetes (Arauz-Pacheco et al 2002). In addition, most epidemiological studies have used levels of 160 mmHg for systolic and 90 mmHg for diastolic blood pressure (Arauz-Pacheco et al 2002). The UKPDS 38 studied 1,148 patients with type 2 diabetes and hypertension, with a baseline blood pressure of 160/94 mmHg and evaluated the effects of different levels of blood pressure on diabetic complications. In the study 758 patients were allocated to what was at the time tight blood pressure control (<150/85 mmHg) and 390 were allocated to less tight control (<180/105 mmHg). Patients in the tight control group reduced their blood pressure to 144/82 mmHg whereas those in the less tight control group reduced to 154/87 mmHg ($p < 0.0001$). Each 10 mmHg decrease in mean systolic blood pressure was associated with reductions in risk of 12% for any complications related to diabetes, 15% for deaths related to diabetes, 11% for myocardial infarction and 13% for microvascular complications. However, 29% of patients in the tight control group required three or more antihypertensive agents to achieve target blood pressure control. The study showed that tight control had a greater overall effect on diabetes related morbidity and mortality than did intensive glucose control, with a 24% reduction in diabetes-

related end points, 32% in deaths related to diabetes and 37% in microvascular end points (nephropathy and advanced retinopathy) (UKPDS (38)1998).

The Hypertension Optimal Treatment (HOT) study (Hansson et al 1998a), involving 18,790 patients of whom 1,501 had diabetes, randomized patients to three different target diastolic groups, ≤ 90, ≤ 85 and ≤ 80 mmHg**.** Among the diabetic group, the group assigned to a target BP of ≤ 80 mmHg had a 51% reduction in major cardiovascular events and 43% reduction in cardiovascular mortality, compared with those with a target BP of ≤ 90mmHg (Hansson et al 1998a, Arauz-Pacheco et al 2002, Berlowitz et al 2003). This study was mainly examining diastolic blood pressure and in fact, the baseline diastolic blood pressure was markedly elevated. In addition, despite the fact that the study population had intensive follow up, more than 50% of patients did not achieve the target of < 80 mmHg (Vijan and Hayward 2003). As in the UKPDS, the targets aimed for in the HOT study were similar to other studies of that era, but were much higher than one would accept in modern diabetes management.

In the Heart Outcomes Prevention Evaluation (HOPE) study (Yusuf et al 2000), involving 9,927 patients, 38% of whom had diabetes, the differences in systolic and diastolic blood pressures were only slight, yet the decreases in risk of myocardial infarction and stroke were similar to those seen in UKPDS. One drawback of both the HOT and HOPE trials is that despite the large numbers of patients with hypertension who were studied, the trials studied relatively small numbers of patients with diabetes (Onuigbo and Weir 2003).

2.3.2 Blood pressure targets

According to Colhoun et al (1998) guidelines for how hypertension is defined and the recommended target for when treatment should commence vary considerably (Myers et al 1989, The JNC V 1993, Sever et al 1993, Jackson et al 1993). The WHO Guidelines for Management of Hypertension (1999) suggest that translating the recommendations from research studies into clinical practice remains a daunting challenge. The JNC V1 (1997), WHO Guidelines Subcommittee (1999) and ADA (2004b), published revised recommendations which recommended a lower target for patients with diabetes (130/85 mmHg), whereas in the general population,

hypertension is defined as a blood pressure of ≥140/90 mmHg. More recently, this target for patients with diabetes has been lowered to < 130 mmHg for systolic and < 80 mmHg for diastolic (Adler et al 2000, Nishimura et al 2001, Arauz-Pacheco et al 2002, De Backer et al 2003, Williams et al 2004, ADA 2004-2008). These recommendations are based on various studies, interpreted to conclude that aggressive blood pressure reduction in patients with diabetes is associated not only with a reduced rate of progression of renal disease but also a decreased incidence of cardiovascular events. Despite the fact that there is no threshold to the benefits of reducing blood pressure, one has to balance aiming for blood pressure control to the lowest level tolerated, while taking into account the patients' tolerance of antihypertensive agents and the risk of side effects (Burden and Burden 2001).

However, treatment remains the subject of controversy and differing clinical opinions, which has led to differences in official recommendations in many countries (Meurin 2006). It is widely recognised that the majority of patients will require more than one agent to achieve target blood pressure (Lazarus et al 1997, Estacio et al 1998, Hansson et al 1998a, UKPDS (38)1998, Feher 2004, Dahlof et al 2005). In fact, to achieve the desired reduction in blood pressure (<130/80) most diabetic patients with hypertension will require between 2 and 4 anti-hypertensive drugs (Bakris et al 2000, Kaplan 2001, Black et al 2001, Cushman et al 2002, Chobanian et al 2003). In the HOT trial, 69% of patients were on at least two drugs, while in the UKPDS, 70% of patients were taking two or more antihypertensive drugs and 29% were taking three or more drugs to achieve the blood pressure targets (Feher 2004).

There is also evidence that earlier blood pressure control improves outcomes. Mounting evidence for the benefits of early combination therapy has led to changes in guidelines (National Cholesterol Education Programme (NCEP) 2001, Chobanian et al 2003). Health professionals and patients often delay initiating treatment for blood pressure until the next visit despite having knowledge that improved blood pressure control is beneficial (Burden and Burden 2001). Traditionally, it is thought that the major barrier to blood pressure control is patient non-adherence to therapy (Borzecki et al 2005). However, research has suggested that clinicians also contribute to the problem of inadequate blood pressure control, through their decisions about whether to initiate or titrate therapy (Berlowitz et al 1998, Oliveria et al 2002, Berlowitz et al

2003). The WHO International Society of Hypertension Guidelines (1999) appreciate there are several factors which contribute to poor control of blood pressure. Fear of side effects can lead to under-dosing of patients by the healthcare professional, contributing to poor blood pressure control. There is lack of clarity in the literature regarding optimal blood pressure, especially in the elderly, in addition to under-utilization of appropriate combinations of anti-hypertensive drugs. Patients are given inadequate education regarding their medication leading to lack of understanding by them of the need to remain on therapy long term. Finally, patients may have difficulty in adhering to lifestyle changes.

2.3.3 International levels of inadequate blood pressure control in both patients with and without diabetes

Despite the body of evidence based knowledge relating to treatment of hypertension and the dissemination of national hypertension guidelines, studies have persistently shown that most patients with diabetes have inadequate BP control (Borzecki et al 2003). In the United States, Saydah et al (2004) compared national data on control of risk factors for vascular disease among adults with previously diagnosed diabetes. Data from the Third National Health and Nutrition Examination Survey (NHANES 111) conducted in 1988 – 1994 was reviewed and compared with data from NHANES 1999-2000. They found that only 35.8% of participants achieved the target systolic BP of less than 130/80 mmHg. In addition, 40.4% of patients had blood pressure levels of $\geq$ 140/90 mmHg. This indicates poor control of blood pressure among adults with diabetes.

Berlowitz et al (1998) studied 800 military veterans without diabetes from 1990 – 1995 and Borzecki et al (2003) carried out a follow up study of 981 military veterans by reviewing their outpatient charts. There were substantial improvements in hypertension control in 1999 compared with the earlier study from 1990-1995 (Berlowitz et al (1998), with 18% of patients having a BP $\geq$ 160/90 mmHg versus 26% in the 1990-1995 study (Berlowitz et al 1998), and 57% having a BP measurement of $\geq$ 140/90 mmHg versus 69% in the 1990-1995 study (Berlowitz et al 1998). However, only 27% of patients in their study had a blood pressure < 140/90 mmHg. With more patients receiving antihypertensive medication and more increases in dosage, suggesting that hypertension was treated more aggressively, still

only 24% of people with hypertension achieved the blood pressure goal <130/85 mmHg recommended by JNC VI. When a subgroup of patients who had diabetes was analysed, despite recommendations for tighter control in patients with diabetes, 77% had a BP ≥130/85 mmHg and 60% had a BP ≥140/90 mmHg. Two further studies also highlighted the lack of tight BP control in patients with diabetes. Chin et al (2000) found that 85% of patients with diabetes had BP's higher than 130/85 mmHg and Harris (2000) found that 59% of patients with diabetes and hypertension had a BP of > 140/90 mmHg.

In a random sample from the adult English population of 12,116 adults who participated in the 1994 Health Survey for England (Colhoun et al 1998), 50% of patients were receiving treatment for hypertension and 30% of patients had BP of <160/95 mmHg, which was the target at that time. When the data from the 1994 UK Health Survey was re-examined, using the target of <140/90 mmHg, which was used in US NHANES 111 survey, only 6% of hypertensive patients had blood pressure below 140/90 mmHg (Colhoun et al 1998). A study by Primatesta et al (2001), which compared the Health Survey for England 1994 data with data from 1998, showed that the percentage of patients with BP maintained below 140/90 mmHg had only increased from 6% to 9%. This may be due to the fact that British Hypertension society guidelines (Ramsey et al 1999) are more conservative with regard to management of systolic blood pressure than the JNC V1 guidelines (Borzecki et al 2003). Another study which compared BP over time (Psaty et al 2002), which enrolled 5775 adults and studied them from 1990 – 1999, found that at baseline, 63% had a BP of ≥140/90 mmHg, and this improved to 51% by 1999.

Epidemiological surveys (JNC V1 1997, Mancia et al 1997) indicate that less than 30% of patients with hypertension have blood pressure treated to below 140/90 mmHg. Interestingly, looking at the current recommended target of < 130/80 mmHg for people with diabetes, a retrospective review of pharmacy and medical insurance claims data and medical charts by Godley et al (2005) found that a blood pressure goal of less than 130/85 was achieved in 19.7% patients, but a goal of less than 130/80 mmHg was only achieved in 13.8% patients. This data indicated that blood pressure control remains inadequate and that a considerable gap exists between guideline recommendations for hypertension treatment and achieved levels of blood

pressure control (Burt et al 1995, Berlowitz et al 1997, Alexander et al 1999, Borzecki et al 2003, Godley et al 2005). The European CODE-2 study (Liebl et al 2002) found that only 35% of the diabetic study population, achieved systolic blood pressure levels ≤ 140 mmHg and 53% achieved diastolic blood pressure ≤ 85 mmHg.

2.3.4 Blood pressure management

The JNC 7 report (Chobanian et al 2003) documents the failure of the health care system to translate knowledge about hypertension into therapeutic action. In individuals aged 40 to 70 years, each increment of 20 mmHg in systolic blood pressure or 10 mmHg in diastolic blood pressure, beginning at 115/75 mmHg, doubles the risk of cardiovascular disease (Lewington et al 2002). The importance of aggressive treatment of hypertension in patients with diabetes is well recognized (White et al 2000). However, studies demonstrate that patients do not achieve recommended levels of blood pressure control, with many patients having a blood pressure of > 140/90 mmHg (Martin et al 1995, Harris 2000, Chin et al 2000). A prospective study by Ruilopa et al (1999) comparing combination antihypertensive therapy versus monotherapy in patients with type 2 diabetes with inadequate blood pressure control, found that combination therapy is more effective in reducing diastolic BP than monotherapy. Target values were 140/90 mmHg and they found that more than 75% of patients achieved blood pressure below 90 mmHg, but only 40% reached systolic blood pressure below 140 mmHg. Lifestyle modifications have also been shown to be beneficial in the management of patients with hypertension (Plantinga et al 2005, Elmer et al 2006). Moderate intense physical activity such as 30-45 min of brisk walking most days of the week has also been shown to lower blood pressure (JNC V1 1997).

Onuigbo and Weir (2003) suggest that historically it was assumed that systolic blood pressure increased with age and was of no significance, therefore treatment was more aimed at lowering diastolic blood pressure (Weir 1999). However, according to Kottke et al (2003), the JNC 7 emphasized that systolic blood pressure control should be the focus of treatment. In persons over 50 years of age, systolic blood pressure of greater than 140 mmHg is a more important cardiovascular disease (CVD) risk factor than diastolic blood pressure. As far back as 1969, Kannel et al suggested that elevation of systolic blood pressure predicts the risk of cardiovascular disease better

than increases in diastolic blood pressure. Basile (2002) notes that, although this was observed more than three decades ago, no attempt was made to translate this evidence into practice until 1993, when JNC V (1993) recognised isolated systolic hypertension as an important target for the control of blood pressure. Systolic blood pressure however, remains more difficult to control than diastolic blood pressure (Hyman and Pavlik 2001, Chobanian et al 2003). In clinical trials where treatment is protocol driven and participants are willing, most patients fail to achieve systolic blood pressure below 140 mmHg (Mancia and Grassi 2002). It is important to persist with aiming to reduce the systolic blood pressure, as Adler et al (2000) found that the incidence of complications was significantly associated with systolic blood pressure and that each 10 mmHg reduction in systolic blood pressure was associated with significant reduction in mortality and morbidity. They suggested that there is no specific target blood pressure to aim for but that the nearer to normal blood pressure the lower the risk of complications.

One reason for inadequate control of hypertension is low patient adherence to treatment (Aminoff and Kjellgren 2001). Long-term adherence can be as low as 50% (Sackett et al 1978, Jones et al 1995, Kjellgren et al 1995). It was suggested by JNC V1 (1997) and WHO (1999), that the use of multidisciplinary teams to treat hypertension could improve adherence to treatment. Physicians have the responsibility for setting blood pressure goals and prescribing anti-hypertensive medication. Specially trained nurses also play an important education role in hypertension management, in addition to encouraging lifestyle changes (Ramsey et al 1999, Steptoe et al 1999, Aminoff and Kjellgren 2001). In addition, Clarke et al (1995) suggested that the nature and quality of communication at follow-up appointments are of vital importance for adherence and Andersson and Mattsson (1994) suggest that good consultations depend not on the length of the consultation but on the healthcare provider. Schroeder et al (2004) also suggest that simplifying dosing regimes appears to be effective in increasing adherence to blood pressure medications.

Recommendations from the National Service Framework for Diabetes (Department of Health (DOH), (2001) and Diabetes UK (2005) acknowledge that tight control of blood pressure is vital to improve morbidity and mortality, but suggest healthcare

providers and patients need to work together to agree individualised blood pressure targets and care plans. Regardless of therapy, hypertension will only be controlled if patients are motivated with regards to their treatment. A positive experience, trust in the clinician and empathy improves patient motivation and satisfaction (Chobanian et al 2003).

2.3.5 Cost-effectiveness of blood pressure control

Until the UKPDS 40 (1998) there was no cost-effectiveness analysis of treatment of hypertension in diabetes (Arauz-Pacheco et al 2002). Tight control of blood pressure in the UKPDS 40 (1998) increased the costs of antihypertensive drugs by an average of £613 per patient compared with less tight control, throughout the study period. However, they concluded that tight control of blood pressure in hypertensive patients with type 2 diabetes substantially reduced the cost of complications and delayed the onset of complications. Analysis of the HOT study (Jonsson et al 2003) showed that the average cost of drugs and visits increased with more intensive treatment and as the target for hypertension treat was lowered. It concluded that in patients with diabetes, intensive treatment to a lower target is cost-effective.

2.4 Hyperglycaemia

Much of the attention in diabetes care focuses on the management of hyperglycaemia, because diabetes is defined by blood glucose levels. Chronic hyperglycaemia, which often precedes the diagnosis of Type 2 diabetes for many years, can cause extensive vascular damage and lead to the early development of clinical complications (Bailey et al 2005). Approximately 50% of patients with newly diagnosed type 2 diabetes already have diabetic tissue damage (UKPDS VIII, 1991). In addition, both diabetic retinopathy and neuropathy are frequently present (Harris et al 1998). The UKPDS 17 (1996**)** found that approximately 9% of patients with type 2 diabetes developed microvascular disease within 9 years of diagnosis, but 20% developed a macrovascular complication which accounted for 59% of deaths in these patients. Indeed, the relative risk for myocardial infarction appears to increase with any increase in glycaemia above the normal range (Fuller et al 1983, Balkau et al 1998), whereas, the risk for microvascular complications is thought to occur only with extreme levels of hyperglycaemia (Jarrett and Keen 1976, Pettitt et al 1980, Krolewski et al 1995).

The UKPDS 33 (1998) found that intensive blood glucose control with sulphonylurea's or insulin reduced the risk of microvascular complications but not macrovascular disease. However there was a trend toward fewer CHD events in the intensive blood glucose control group. Similar results were achieved with Metformin in a separate trial (UKPDS 34, 1998). According to Balkau et al (1999) and Coutinho et al (1999), no threshold for fasting plasma glucose has been identified in relation to cardiovascular deaths. More recently, Stratton et al (2000) found no thresholds of glycaemia for any complication of diabetes; however, each 1% reduction in HbA1c was associated with a 37% decrease in risk for microvascular and 21% decrease in the risk of any end point or death related to diabetes. These results suggest that it is hyperglycaemia itself which may attribute to cardiovascular risk in patients with diabetes and that one should aim for HbA1c as near normal as possible (Stratton et al 2000).

2.4.1 Development of insulin resistance

According to Barnett (2006), the development of insulin resistance, impaired glucose tolerance and type 2 diabetes occurs gradually over many years. Initially the pancreatic islet cells are able to respond to insulin resistance by increasing insulin secretion, but as the disease develops, there is a progressive loss of β-cell function (Barnett 2006). Several studies have shown that deterioration in β-cell function in fact precedes the development of type 2 diabetes mellitus by many years (UKPDS 16, 1995, Levy et al 1998, Weyer et al 2001, Bagust and Beale 2003, Del Prato and Marchetti 2004). Many patients with new onset of type 2 diabetes mellitus have less than 50% of normal insulin secretion at diagnosis and less than 25% six years after diagnosis (UKPDS 33, 1998). Declining β-cell function is associated with deteriorating glycaemic control (UKPDS 16, 1995, UKPDS 33, 1998). Data from UKPDS 16 (1995) and the Belfast diet study (Bagust and Beale 2003) have revealed that β-cell dysfunction could be commencing up to 15 years prior to diagnosis. In addition, around 80 - 85% of patients with type 2 diabetes are insulin resistant (Bonora et al 1998, Haffner et al 2000), which is an independent risk factor for CVD (Bonora et al 2001).

When considering the burden of disease attributable to type 2 diabetes mellitus it would be incorrect to consider diabetes mellitus in isolation (Cockram and Tong 2004). An increased risk of coronary heart disease exists at the stage of impaired glucose tolerance (IGT) (Eschwege et al 1985, Cockram and Tong 2004). There is considerable evidence that elevated post-prandial glucose levels are an independent risk factor for the development of cardiovascular disease (Monnier et al 2003, Gerich 2003), which is the main cause of morbidity and mortality in type 2 diabetes (Heine et al 2004). It is suggested that to achieve target HbA1c levels, assessment of pre and postprandial glucose measurements are important (American Association of Clinical Endocrinologists (AACE) 2002, Heine et al 2004). A more recent study by Barr et al (2007) emphasized the strong association between abnormal glucose metabolism and mortality and suggested that CVD prevention may be warranted in people with all categories of abnormal glucose metabolism.

2.4.2 Management of hyperglycaemia

Frequent monitoring of glycaemia, by means of glycated haemoglobin (HbA1c), is essential for effective glycaemic management (Del Prado 2005). Carbohydrates such as glucose, bind non-enzymatically to proteins such as haemoglobin, in a process called glycation, which occurs over the 120-day life span of red blood cells (Alam et al 2005). The HbA1c value is thought to represent average glycaemia over the preceding three months but recent glycaemia has the largest influence, with plasma glucose levels in the preceding 30 days contributing about 50% to the final HbA1c result (Tahara and Shima 1995). The HbA1c accurately reflects the patient's glycaemic control (Hutchinson and O'Shea 2006, ADA 2007), except in situations where the lifespan of the erythrocyte is affected, such as with renal failure and haemolytic diseases (Kilpatrick 2000, LeRoith and Smith 2005). HbA1c reflects long term glycaemic control, whereas fasting plasma glucose (FPG) and postprandial plasma glucose (PPG) are used to assess day to day glucose control (LeRoith and Smith 2005). A disadvantage of HbA1c testing is that it does not give an indication of the stability of glycaemic control or glucose fluctuations (Kilpatrick 2000). However, both HbA1c and plasma glucose profiles from self monitoring of blood glucose (SMBG) are needed to truly ensure good glycaemic control (Alam et al 2005).

The clinical course of type 2 diabetes is characterised by a gradual decline in β cell function, therefore treatment needs to be adjusted regularly (Heine et al 2006). The optimal management of patients with diabetes requires that treatment should be tailored to the requirements of the patient (Campos 2007). According to Campbell (2000), there are two approaches to the management of type 2 diabetes, the conservative stepwise approach and the intensive target orientated approach. The traditional approach to the management of hyperglycaemia was more conservative using a stepwise approach, of lifestyle modifications, oral monotherapy, combination therapy, and finally treatment with insulin with or without oral hypoglycaemic agents (Heine et al 2006). Many physicians only intensify treatment when symptoms of poor glycaemic control become apparent, instead of when glycaemic targets are not being met (Campbell 2000). The intensive approach is more aggressive from diagnosis, with the use of a combination of agents at an earlier stage (Lebovitz 1994, Mudaliar and Henry 1999, De Fronzo 1999). By using this form of treatment, the aim is to reduce the fasting plasma glucose (FPG) and HbA1c to target range at an early stage, thereby minimising the risk of complications (Campbell 2000).

2.4.3 Guidelines for glycaemic control

Over the past number of years many guidelines have been advocated, nationally and internationally (European Diabetes Policy Group 1999, Latin American Diabetes Association 2000, Asian-Pacific Type 2 Diabetes Policy Group 2002, American Association of Clinical Endocrinologists 2002, Canadian Diabetes Association 2003, American Diabetes Association 2007). However, guidelines for glycaemic control differ among major professional bodies (See Table 2.4.1).

Table 2.4.1 Guidelines for Glycaemic Control

American Association of Clinical Endocrinologists (ACE)	2002	< 6.5%
De Backer et al	2003	≤ 6.1%.
JBS 2	2005	< 6.5%
IDF	2005	< 6.5%
ADA and European Association for the Study of Diabetes	2006	<7%
ADA	2008	< 7%, but as close to non-diabetic range (< 6%) as possible

As a result, the International Diabetes Federation (IDF 2005) have developed Global Guidelines for Type 2 diabetes, which represent the evidence base for target glucose

control, which are cost-effective and outline practical recommendations for different standards of care, depending on the resources and expertise available to the country. Therapy should be targeted to achieve an HbA1c < 6.5% which will provide significant benefits in terms of reducing the risk of micro-macrovascular complications (Diabetes Control and Complications Trial (DCCT) 1993 and 1995, Standl et al 1996, UKPDS 33 1998, Stratton et al 2000, American College of Endocrinology 2002, Rohlfing et al 2002). Stratton et al (2000) showed that every 1% drop in HbA1c is associated with 21% reduction in risk for any diabetes-related endpoint, 21% for deaths related to diabetes, 14% for myocardial infarction and 37% for microvascular complications. Epidemiologic data shows that there is no HbA1c level below which the risk of complication does not continue to decrease (ADA 2005), suggesting that the lowest risk of complications would be in those with HbA1c values in the normal range (<6%) (Stratton et al 2000).

2.4.4 Inadequate management of glycaemic control

While it is well established that good glycaemic control plays a key role in reducing diabetes-related complications (UKPDS 33 1998, UKPDS 34 1998), over 60% of patients are not reaching glycaemic targets (Liebl et al 2002, Saydah et al 2004). Several large-scale studies have shown that the current management of glycaemia is falling short of accepted treatment goals (Liebl et al 2002, Gaede et al 2003, Charpentier et al 2003, Rothenbacher et al 2003, Monnier et al 2003, Saydah et al 2004). Only 37% of participants in NHANES 1999-2000 achieved the target goal HbA1c level of less than 7%, which was not significantly different from NHANES 111 data where 44.3% had achieved the target of less than 7% (Saydah et al 2004). The European CODE-2 study (Liebl et al 2002) found that only 31% of the study population achieved glycaemic control at or below 6.5%. There appears to be a reluctance to change practices by physicians (Del Prado 2005). According to the Diabetes in Canada Evaluation (DICE) study (Harris et al 2005), although the majority of physicians were dissatisfied with HbA1c levels > 7%, reinforcing lifestyle (79%) was the most common plan to achieve glycaemic target levels. More aggressive treatment plans (intensified pharmacologic therapy and/or referral) were cited for only 56% of patients, this included increasing the dose of oral agent (28%), add oral agent (18%), refer to specialist (13%), increase dose of insulin (10%) or add insulin (6%).

There is mounting evidence that earlier intervention, through both lifestyle and pharmacological management, including earlier combination therapy, can alleviate the burden of complications in type 2 diabetes (Bailey et al 2005). Indeed there is substantial evidence linking chronic hyperglycaemia to an increased risk of cardiovascular disease (Selvin et al 2004), which is the chief cause of mortality among patients with diabetes (Morrish et al 2001, Roglic et al 2005). A recent study showed that the greater risk of death from CVD, Ischaemic heart disease (IHD) and all cause mortality was when the HbA1c level was above 7% (Khaw et al 2004). The Steno-2 study (Gaede et al 2003) and NHANES data (Sayah et al 2004) found poor attainment of HbA1c targets compared with blood pressure and lipid values. This may be partly due to the fact that for too long hyperglycaemia has been perceived as a benign condition, whereas there appears to be a greater awareness of the risks associated with hypertension and hypercholesterolemia (Bailey et al 2005).

2.4.5 Pharmacological treatment for type 2 diabetes

Hyperglycaemia in people with diabetes is a progressive condition due to progressive islet β cell failure and requires continued monitoring and titration of therapies to maintain glycaemic targets (IDF 2005). It has been demonstrated that maintaining tight glycaemic control remains a challenge, even in the controlled setting of clinical trials (Vora 2006). Lifestyle modification can be effective in some patients after diagnosis of type 2 diabetes, but early pharmacological intervention is indicated if lifestyle measures are not effective (Bailey et al 2005), with most oral agents lowering HbA1c concentrations by 1-2%. The UKPDS demonstrated the difficulty in maintaining glycaemic control with monotherapy and found that by 9 years of diagnosis with diabetes 75% of patients will need combination therapy to achieve HbA1c levels below 7% (Turner et al 1999). A strategy of earlier use of combination therapy to manage glycaemic control has potential advantages, including more rapid achievement of therapeutic goals and potential to delay disease progression and possibly prevent complications (Bailey et al 2005). The Canadian Diabetes Association (2003) caution that delaying combination therapy makes it harder to achieve therapeutic targets.

Biguanides (Metformin) and Sulphonylureas, remain the mainstay of pharmacological treatment for type 2 diabetes for those inadequately controlled with

diet and lifestyle management (Cohen and Shaw 2007). Biguanides decrease blood glucose levels by acting on insulin target cells in the liver, muscle and fat. Sulphonylureas stimulate insulin secretion (Cohen and Shaw 2007). In recent years, the thiazolidinediones or glitazones, which improve insulin sensitivity (Cohen and Shaw 2007) and possibly preserve ß-cell function (Kendall 2006), have established a role in the treatment of type 2 diabetes. Two newer class of oral hypoglycaemic agents have also been developed which have significant clinical potential, namely dipeptil peptidase 4 (DPP-4) inhibitors and incretins (Cohen and Shaw 2007). DPP-4 inhibitors enhance the body's own ability to control blood glucose by increasing the levels of incretin hormones in the body. They trigger pancreatic insulin secretion, suppress pancreatic glucagons secretion and signal the liver to reduce glucose production. Whereas, incretins are a group of intestinal hormones, (i.e. Glucagon-like peptide (GLP-1)) which act on the pancreatic ß-cells to promote insulin secretion and α-cells to inhibit glucagon secretion, they also inhibit gastric emptying. This group of agents are thought to be of importance in controlling post-prandial blood glucose levels (Cohen and Shaw 2007). Studies (Vilsboll and Holst 2004, Holst 2006, Drucker 2006) have shown both the GLP-1 analogues and DPP-4 inhibitors to be effective either alone or in combination with other oral hypoglycaemic agents (Cohen and Shaw 2007). Vervoort and Tack (2007) suggest that the development of new classes of glucose-lowering medications has expended the treatment options for type 2 diabetes, but has also introduced more uncertainty regarding which treatment option is the most appropriate. Heine et al (2006) suggest that a combination of three oral agents for lowering blood glucose should only be considered when patients are already close to target and when circumstances make it difficult to use insulin and suggest that in general when target HbA1c has not been achieved by dual oral therapy, the next step should be basal insulin therapy.

In the past, it was standard practice to stop all oral hypoglycaemic agents once starting insulin. More recently, insulin is often used in combination with various oral agents (Douek et al 2005), for example, a once daily basal insulin in combination with one or more oral agents (Feinglos and Bethel 2005). A number of studies (Aviles-Santa et al 1999, Hermann et al 2001, Wulffele et al 2002, Jones et al 2003) found that patients on insulin in combination with Metformin, which improves insulin sensitivity, achieved better glycaemic control, often at a lower insulin dose, and does

not predispose to weight gain, although there is still weight gain associated in the early stages of insulin therapy. In addition, the UKPDS 34 (1998) found there was reduced cardiovascular risk in those randomized to Metformin therapy with insulin.

2.4.6 Insulin therapy and insulin regimes

Due to the progressive loss of ß-cells function, a substantial number of patients with type 2 diabetes will require insulin (Turner et al 1999), usually when glycaemic control with oral hypoglycaemic agents is suboptimal (Nathan et al 2006). However, despite the many clinical benefits of insulin therapy for patients with type 2 diabetes, many patients and physicians are reluctant to initiate insulin treatment, despite the recognition that glycaemic targets are not being achieved (Harris et al 2005, Campos 2007). This reluctance to initiate or intensify insulin therapy by both patients and healthcare providers has been well documented (Vora 2006). Ziemer et al (2005) reported that 'clinical inertia' may be a barrier to maintaining tight glycaemic control. The Diabetes Attitudes, Wishes and Needs (DAWN) study (Peyrot et al 2005) found that 50-55% of nurses and GP's delayed insulin therapy until absolutely necessary. One of the barriers to initiation of insulin by physicians may be concern about the possible side effects, such as weight gain and hypoglycaemia (Dailey 2005, McMahon and Dluhy 2007). Many patients with type 2 diabetes are often overweight at diagnosis (Tremble and Donaldson 1999) and insulin is associated with weight gain and often, when used alone, does not adequately improve glycaemic control (Douek et al 2005).

The UKPDS 33 (1998) found that all therapies for treating type 2 diabetes were associated with weight gain over the period of the study and the UKPDS 13 (1995) found that patients had an average weight gain of 5 kg in first 12 months of insulin treatment. In the DCCT (1993), approximately 32% of intensively treated patients required additional counselling for weight management. Therefore, weight gain may be a psychological barrier to the introduction of insulin therapy in type 2 diabetes (Korythowski 2002, Fritsche and Haring 2004). Despite this fact, it has been suggested that insulin therapy should be initiated earlier and not used as a 'last resort' to achieve glycaemic control (Campbell and White 2002, Polonsky and Jackson 2002, Home et al 2003). There is no agreed upon optimal mode of initiating insulin therapy in patients with type 2 diabetes who have failed to maintain glycaemic control on oral

agents, but the key factor is to continue to intensify treatment until targets are achieved and maintained (Davidson 2005). However, the question of how to initiate insulin therapy in patients with type 2 diabetes has become more complicated as the range of insulin preparations with differing time-activity profiles has expanded, though basal insulin treatment is usually sufficient to bring most patients close to the HbA1c target, but attaining normal glucose levels usually requires the addition of prandial insulin (McMahon and Dluhy 2007).

Recently Holman et al (2007) in the 4-T trial, which looked at the addition of biphasic, prandial or basal insulin to oral therapy in type 2 diabetes, found that there was a substantial weight gain in all groups of patients. However, biphasic or prandial insulin was associated with greater weight gain and more risk of hypoglycaemia. According to Hunt et al (1997) physicians may communicate negative attitudes toward insulin therapy and imply it is a sign of failure of the patient to comply with earlier treatment. There are many reasons for patients' reluctance to start insulin. These include anxiety about learning how to manage insulin therapy, side effects, possible needle phobia or previous experience of insulin therapy. Also, patients may have the misconception that the need to start insulin therapy means that their diabetes has advanced to a more serious stage. Physicians must therefore ensure that they do not give the impression that insulin constitutes failure on the patient's part (Hunt et al 1997). It is important to explore the potential barriers to treatment with each patient as there may be a language barrier, which can complicate the initiation of insulin therapy and in many cases requires the use of interpreters or family members to enable the patient to accept and adhere to the insulin regime (Campos 2007).

There is now a growing trend toward more aggressive treatment regimes and insulin is being introduced earlier to achieve target HbA1c levels, which are defined by many national organisations (European Diabetes Policy Group 1999, American College of Endocrinology 2002, NICE 2002**,** Korythowski 2002, Nathan et al 2006), in order to reduce long-term complications in type 2 diabetes (Rosenstock et al 2005). There are now many treatment options for insulin therapy, with new insulin analogues which have improved the absorption profile of insulin, resulting in lower incidence of hypoglycaemia and less variation in insulin absorption (Cohen and Shaw 2007). Basal insulin can be used safely in combination with oral hypoglycaemic agents in

patients with type 2 diabetes (Zammitt and Frier 2005). Physicians should consider starting basal insulin therapy in combination with existing oral hypoglycaemic regime in patients whose HbA1c level is > 7% or >6.5% if using the ACE (2002) and the JBS 2 (2005) guidelines (Campos 2007). However, patients may need the addition of prandial insulin to basal insulin if their fasting glucose level is optimal but their HbA1c level is still > 7% or if their post meal glucose levels are above target (Campos 2007). Premixed insulin requires rigid adherence to regular mealtimes (Campos 2007) and is possibly more suited to patients who are unable to adhere to more complex regimens (Hirsch 2005). Inhaled insulin, using short acting insulin, is a 'needle free' treatment option which to date is not widely used. Absorption is affected by active lung disease and is also contra-indicated in this group of patients and smoking has been shown to increase absorption of inhaled insulin thereby increasing risk of hypoglycaemia and is contra-indicated (Cohen and Shaw 2007).

2.4.7 Hypoglycaemia

Hypoglycaemia is the most limiting factor associated with the glycaemic management of diabetes (Cryer 2002, Davis and Alonso 2004). It was noted as the most common and well-recognised adverse effect of intensive therapy in the DCCT (1993 and 1995) and UKPDS 33 (1998). Hypoglycaemia has in the past been considered a mild and infrequent side effect of treatment in type 2 diabetes most frequently with insulin therapy, but sulphonylurea-induced hypoglycaemia is also a significant problem (Zammitt and Frier 2005). It is a significant complication of diabetes therapy, with mild hypoglycaemia causing unpleasant symptoms and affecting patients' daily lives, and severe hypoglycaemia potentially resulting in coma, seizure and death (Miller et al 2001). Hypoglycaemia may also provoke major vascular events, such as stroke, myocardial infarctions, acute cardiac failure and ventricular arrhythmias (Landstedt-Halin et al 1999, McAulay and Frier 2001, Desouza et al 2003).

Mild hypoglycaemia is often defined as when the patient can recognise and treat their symptoms of hypoglycaemia without assistance, while severe hypoglycaemia is regarded as when external assistance is required (Zammitt and Frier 2005). Recurrent episodes of mild hypoglycaemia can lead to hypo unawareness (Gold et al 1994, Cryer 2002). Intensive glycaemic control and lowering the HbA1c to a target of

< 7% (McCrimmon and Frier 1994, Rosenstock and Riddle 2004), particularly with insulin therapy, is associated with an increased incidence of hypoglycaemia, which is the major barrier to the implementation of intensive treatment from the physician's and the patient's perspective (Thompson et al 1996, Davis and Alonso 2004). Aggressive management aimed at achieving near-normal glucose levels was associated with increased hypoglycaemia, with the highest prevalence seen in patients receiving insulin therapy who had a HbA1c level of less than 7%, but severe hypoglycaemia was rare and therefore it was suggested that concerns about hypoglycaemia should not change efforts to achieve tight glycaemia control in patients with type 2 diabetes (Miller et al 2001). However, Leese et al (2003) suggested that hypoglycaemia requiring emergency assistance is as common in patients with type 2 treated with insulin therapy as in patients with type 1 diabetes and is associated with an increased economic cost.

According to Zammitt and Frier (2005), hypoglycaemia with oral anti-diabetic agents is associated with insulin secretagogues, ie sulphonylurea's, and Jennings et al (1989) suggest that hypoglycaemia is more common in patients with type 2 diabetes on sulphonylurea's than one would expect. Their study of 219 patients treated with sulphonylureas and or Metformin found that 20% of those taking sulphonylureas had experienced symptoms of hypoglycaemia in the preceding 6 months. Hypoglycaemia is the most serious complication associated with glycaemic management of the elderly (Meneilly and Tessier 1995, McAulay and Frier 2001, Davis and Alonso 2004), many of whom are physically frail and have co-existing macrovascular disease and are at increased risk of injury and bone fractures as a result of general frailty and other co-morbidities such as osteoporosis (McAulay and Frier 2001). Frequent and unpredictable hypoglycaemia in the elderly can undermine their self-confidence and have an effect on their independence and ability to live alone (McAuley and Frier 2001). Recurrent hypoglycaemia can place a huge burden on relatives and carers of the elderly and in some cases can affect the individual's ability to live alone and possibly mean that the individual has to go into residential care (McAuley and Frier 2001). In addition, the elderly may have inadequate retention of information as a result of age-related cognitive decline (McAulay and Frier 2001), and therefore they must be carefully monitored and educated on the symptoms and treatment of hypoglycaemia (Davis and Alonso 2004). In addition, regular reinforcement of

education is required (McAulay and Frier 2001). In view of the fact that hypoglycaemic can result from inadequate dietary intake or excessive physical exercise, patient education regarding the signs, symptoms and management of hypoglycaemia is vital (Davis and Alonso 2004, Campos 2007).

2.4.8 Self monitoring of blood glucose

There is strong evidence that intensive glycaemic control is cost-effective in reducing microvascular complications of type 2 diabetes (UKPDS 33, 1998, Gray et al 2000). Once a patient is diagnosed with diabetes, self-monitoring of blood glucose (SMBG) should be considered as part of the treatment plan for all patients as part of an overall diabetes treatment plan, which provides specific instructions on how, when and why to test (Davidson 2005, Renard 2005). SMBG is a diagnostic and an educational tool for both patients and healthcare providers, to understand the effects of diet, exercise and medications on day-to-day glycaemic control (Renard 2005, Bergenstal et al 2005, Davidson 2005, Martin et al 2006). Blood glucose consensus guidelines published by Owens et al (2004) suggest that self-monitoring of blood glucose empowers people with diabetes to understand and thereby manage their own glycaemic control.

There is however, controversy as to whether patients with type 2 diabetes should perform self-monitoring of their blood glucose and also the frequency of testing (Faas et al 1997, Coster et al 2000). As well as increasing the burden of self-care for the patient, SMBG increases direct health care costs (Mathers and Penm 1999, Colagiuri et al 2003). Franciosi et al (2001) found that for patients with type 2 diabetes not on insulin, SMBG increased the psychological burden of the disease and was related to higher levels of distress and worry. However, a number of studies have shown that SMBG is an important part of the management of patients with type 2 diabetes (Goldstein et al 2004, Sarol et al 2005, Welschen et al 2005, Bergenstal et al 2005, IDF 2005).

The recent RetrOlective Study: Self-Monitoring of blood glucose and Outcome in Patients with Type 2 Diabetes (ROSSO) study (Martin et al 2006), which involved 3,268 patients, demonstrated that patients with type 2 diabetes who self-monitored their blood sugars had significantly lower morbidity and mortality. In addition, it

found that patients were more aware of their blood glucose levels, sought advice sooner and had more frequent adjustments to their medication if their levels were outside the target range. However, an observational study carried out by Davis et al (2006) showed that there was no significant difference in HbA1c between those patients who self-monitored their blood glucose and Davis et al (2007) found that SMBG was not independently associated with improved survival in this group of patients.

There are a number of recommendations by different groups on the frequency of self-monitoring of blood glucose, but as with all treatment, the healthcare professional needs to tailor the recommendation to the individual patient, their treatment regime and their lifestyle (Bergenstal et al 2005). Both the HbA1c which assesses long-term glycaemic control over the lifespan of the typical red cell and averages out the swings of daily blood glucose fluctuations and SMBG which determines recent patterns of pre-prandial and postprandial glucose and provides feedback on the effects of diet, exercise and lifestyle, are essential for assessing glycaemic control (Bergenstal et al 2005). The ADA (2007) recommendations suggest that SMBG should be performed 3 or more times per day for those patients on multiple daily injections of insulin. Davis et al (2006) concluded that SMBG can be of value in the identification and prevention of hypoglycaemia and for dose adjustment of those patients who are being treated with insulin therapy.

Blonde et al (2002) suggest that SMBG forms the basis upon which the clinician can interpret the individual patient's glycaemic profile. SMBG allows people with diabetes to monitor their condition and manage it on a day-to-day basis through the adjustment of treatment and lifestyle factors (Hicks 2005). However, a study by Avery and Moore (2006) using a questionnaire to determine current practice with regard to self-monitoring of blood glucose in people with diabetes, found that only 44/361 respondents altered their treatment based on the results of their blood testing. Self-monitoring of blood glucose will not improve glycaemic control or quality of life if it is not used properly or if patients are not educated (Alford 2004). People with diabetes need to know how to interpret results in terms of lifestyle and treatment (Hicks 2005). Where possible, patients with diabetes should be taught to adjust their insulin in addition to changing lifestyle factors, such as diet and exercise, which may

be influencing their blood sugar results (Gadsby 2005), however, the patient must be confident that they have the ability to adjust either their medication or lifestyle factors accordingly (Hicks 2005).

SMBG enables the patient to immediately identify and manage hyperglycaemia or hypoglycaemia (LeRoith and Smith 2005). In addition, increased use of blood glucose monitoring has been shown to improve medication compliance (Karter et al 2001, Soumerai et al 2004). However, Thompson (2001) suggests that the accuracy of SMBG depends on both the instrument used and the person doing the testing. Healthcare providers should evaluate the patient's technique initially and at regular intervals. But as with all aspects of diabetes care the key to effective SMBG is education (Hicks 2005, Owens et al 2005). Ongoing education regarding the use and interpretation of results by patients and healthcare providers is essential for successful implementation of SMBG (Bergenstal et al 2005).

2.4.9 Cost effectiveness of good glycaemic control

The UKPDS provides the necessary clinical information on both microvascular and macrovascular complications to allow the cost effectiveness of improved glucose control in patients with type 2 diabetes to be analysed (Gray et al 2000). Intensive glucose control increased trial treatment costs by £695 per patient but reduced the cost of complications by £957 compared with conventional management (Gray et al 2000). According to Burrill (2002), the cost of home blood glucose monitoring is a legitimate concern of healthcare providers. In 2001, approximately £90 million Stg was spent on blood glucose testing strips for people with diabetes (National Prescribing Centre 2002), which is estimated to be 40% more than the amount spent on oral hypoglycaemic agents used to lower blood glucose levels (Tiley 2002). In addition, Davis et al (2006) estimated that the projected average annual cost of using SMBG would be Aus$51 million when projected to include the type 2 diabetes population in Australia. In view of the epidemic of diabetes, there are implications for the healthcare budget as costs will escalate over the coming years. However, Karter et al (2003) suggests that the long-term healthcare savings achieved by preventing complications associated with diabetes would likely outweigh the short-term costs of increased use of self-monitoring of blood glucose.

2.5 Dyslipidaemia

The development of atherosclerosis and clinical vascular disease is multifactorial and dyslipidaemia is a major contributing factor (Grundy et al 1999). Dyslipidaemia is common in patients with diabetes and is often present at the time of diagnosis (Betteridge 2001). Diabetic dyslipidaemia is characterized by high triglycerides, low levels of high-density lipoprotein (HDL-c) and the presence of small, dense low-density (LDL) particles (Haffner et al 1998c, Betteridge 2001, Taskinen 2003, ADA 2004, Costa et al 2006, Schwartz 2006, Shepherd et al 2006). According to Turner et al (1998), LDL-c, HDL-c and triglycerides are independent predictors of cardiovascular disease**,** as indeed is total cholesterol (Pyorala et al 1997). As abnormal lipid profiles have a strong association with increased risk of coronary artery disease, early detection (ADA 2000) and aggressive treatment of dyslipidaemia will reduce the risk of CVD in patients with diabetes (ADA 2004).

2.5.1 Evidence-base for the benefit of lipid lowering

A number of major secondary (individuals with clinical and / or angiographic evidence of CHD) lipid-lowering trials have included a substantial number of patients with diabetes (Steiner 2000, Colhoun et al 2002) and have shown substantial reductions in morbidity and mortality (Table 2.5.1). Colhoun et al (2002) noted that there had been no large published trials of lipid-lowering drug therapy conducted solely in patients with diabetes. Therefore the Collaborative AtoRvastatin Diabetes Study (CARDS), involving 2,838 patients, was the first large primary prevention study (individuals without clinical evidence of coronary heart disease), involving diabetes patients alone was undertaken (Colhoun et al 2004). Patients were randomised to placebo or Atorvastatin 10mgs. The trial was terminated 2 years early, after median follow up of 3.9 years due to the fact that a significant difference was reported in interim analysis in favour of Atorvastatin. There was no significant change in HDL-c but triglycerides fell by 21%, and also 3 months into the study 85% of the treatment group had an LDL-c below 2.6 mmol/L.

The Fenofibrate Intervention and Event Lowering in Diabetes (FIELD) study **(**Keech et al 2005), involving 9,795 patients with type 2 diabetes, who were not on statin therapy, examined the effect of fibrate therapy on CV disease events. The results indicated that fibrates could reduce the atherosclerotic burden of patients with type 2

diabetes, by lowering triglycerides. In addition, Fenofibrate significantly reduced microvascular associated complications, including progression of microalbuminuria.

Table 2.5.1 Lipid Lowering Trials

Study	Type of prevention	No of patients	Patients with diabetes	Duration (yrs)	Results
Cholesterol and Recurrent events Trial (Care) 1996	2º	4159	568 (14%)	5	25% reduction in CHD events
Scandinavian Simvastatin Survival Study (4S) subgroup analysis 1997	2º	4444	202 (4.5%)	5	43% reduction in total mortality and 55% reduced risk of major coronary events in patients with diabetes
Long-Term Intervention with Pravastatin in Ischemic Disease (LIPID) 1998	2º	9014	782	6	24% reduction in CHD events
Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial – Lipid Lowering Trial (ALLHAT-LLT) 2002		10,355	3638	4.8	11% reduction in fatal CHD events and nonfatal MI
Heart Protection Study (HPS) subgroup analysis 2003	1º / 2º	20536	5963	5	25% reduction in coronary and vascular event rate in patients with diabetes
Anglo-Scandinavian Cardiac Outcomes Trial-Lipid Lowering Arm (ASCOT-LLA) subgroup analysis 2003	1º	10305	2532	3.3	Lowered incidence of total cardiovascular events by 23%
Collaborative AtoRvastatin Diabetes (CARDS) Study 2004	1º	-	2800	4	37% reduction in major CV events 48% reduction in stroke 36% reduction in acute coronary events 27% reduction in total mortality
Fenofibrate Intervention and Event Lowering in Diabetes (FIELD) study 2005	1º / 2º	-	9,795	5	24% relative reduction in non-fatal MI 19% relative reduction in total CVD events for patients without previous CVD 29% reduction in triglycerides
Treating to New Targets (TNT) subgroup analysis 2006	2º	-	1501	4.9	Reduced the rate of major cardiovascular events by 25%.

2.5.2 Lipoprotein Abnormalities

Elevated plasma triglyceride concentration is a risk factor for fatal and non-fatal cardiovascular events independent of the levels of other blood lipids (Hokanson and Austin 1996, Stampfer et al 1996, ADA 2004) and is associated with abnormalities in thrombosis and coagulations (Hamsten and Karpe 1996). In fact a 1mmol/L rise in the fasting plasma triglyceride concentration is associated with an increased risk for cardiovascular disease (particularly CHD) of about 14% in men and 37% in women

(Hokanson and Austin 1996). The ADA (2004) suggest that improved glycaemia control can be very effective for reducing triglyceride levels and glycaemia should be aggressively managed, however, pharmacological therapy may be required to minimize the risk of pancreatitis. Higher doses of statin's may be moderately effective at reducing triglyceride levels but fibrates may be required in combination with statin therapy in those patients with combined hyperlipidemia (ADA 2004).

HDL cholesterol has protective properties and has a beneficial effect regardless of the LDL-c level (Libby 2004), however, low HDL cholesterol is a powerful predictor of CVD in patients with diabetes. It is difficult to raise HDL cholesterol levels without pharmacological intervention, however, behavioural interventions such as weight loss, smoking cessation and increased physical activity, also play a role in increasing HDL-c (ADA 2004). The value of lowering low-density lipoprotein (LDL) cholesterol levels in prevention cardiovascular events has been well documented (LaRosa et al 2005). Current guidelines for the use of lipid-lowering agents vary around the world (Ramsay et al 1999, National Cholesterol Education Program (NCEP) 2001). A number of recent studies have looked at optimal treatment targets for patients with coronary heart disease (CHD) (Heart Protection Study 2002, Sever et al 2003, Cannon et al 2004, Koren and Hunninghake 2004).

2.5.3 Lipid targets

In the early 1990's the European Atherosclerosis Society (EAS) (1992) and NCEP (1993) developed guidelines to aid in the management of CHD. These guidelines considered numerous factors such as plasma lipid levels and the presence of other diseases and risk factors, in order to make an accurate assessment of a patient's risk for CHD and to recommend target LDL cholesterol goals. These guidelines also proposed lifestyle changes, such as improved diet and exercise and when these are not successful, the initiation of lipid lowering therapy (Bertolini et al 1997). Current guidelines vary for lipid-lowering treatment and primary prevention of cardiovascular disease in type 2 diabetes (Colhoun et al 2004). However, as a result of more recent data (HPS 2002, Canon et al 2004, de Lamos et al 2004, Grundy et al 2004, La Rosa et al 2005, ADA 2005-2007) a more aggressive LDL cholesterol target of less than 1.8 mmol/L, for patients with diabetes who have previous cardiovascular disease, has been recommended.

2.5.4 Failure to attain current recommended Lipid targets in both patients with and without diabetes

Studies show that in clinical practice, most patients treated for dyslipidaemia fail to reach LDL cholesterol goals established by the United States and European guidelines (NCEP 2001, Wood et al 1998). Pearson et al (2000) in the Lipid Treatment Assessment Project (L-TAP) found that despite the fact that 84.6% of patients were receiving treatment with lipid-lowering drugs, only 39% had reached their LDL cholesterol goal. A survey called EUROASPIRE 1 (European Action on Secondary Prevention by Intervention to Reduce Events) (1997), involving 3,569 patients (1995-96) with established CHD, in nine countries, 18% of whom had reported diabetes, was undertaken by The European Society of Cardiology**.** A second survey EUROASPIRE 11 (2001) involving 3,379 patients (1999-2000) in the same countries, 21.9% of whom had reported diabetes, found that the prevalence of cholesterol $\geq$5.0mmol/L had decreased from 86.2% to 58.8%. Also the proportion of patients with a cholesterol concentration of $\geq$6.0mmol/L had decreased from 53.2% to 26.7%. There was an increase from 20.9% to 49.2% in the proportion of patients on lipid-lowering drugs who achieved the target of < 5.0 mmol/L (EUROASPIRE 1 and 11 Group 2001).

Other studies in high-risk patients have shown similar results. De Lusignan et al (2003) in a study which examined the Primary Care Data Quality Programme, found that only 47% of patients had a total cholesterol level $\leq$ 5.0 mmol/L. Evans et al (2003) found that while 73% of patients in the study were being treated with a statin, only 58% had total cholesterol < 5.0 mmol/L. Saydah et al (2004), as mentioned previously, found that over 51.8% of participants in NHANES 1999-2000 had a total cholesterol level of greater than 5.18 mmol/L which had improved from NHANES 111 where 66.1% had a total cholesterol level of $\geq$ 5.18 mmol/L, indicating that a high percentage of at risk patients are not attaining the recommended lipid targets to prevent complications. The European CODE-2 study involving patients with type 2 diabetes (Liebl et al 2002) found that only 21% of the 7,000 study population, achieved total cholesterol levels below 4.8%, but 47% achieved triglyceride levels < 1.7 mmol/L. In addition, 26% of patients had HDL-c levels in the high risk category of less than 1 mmol/L and the data for LDL-c showed that the mean value was 3.6 mmol/L. A more recent study by Erhardt and Hobbs (2007) to ascertain

current practice for the diagnosis and treatment of high cholesterol and attitudes towards dyslipidaemia management among 750 physicians, by way of questionnaires, found that there were discrepancies between guideline recommendations and clinical practice. Although physicians appreciate the risk associated with CVD, the importance of achieving cholesterol goals for preventing CVD was not widely endorsed. More recently Rajagopalan et al (2007) concluded that approximately 75% of British patients would not have achieved the more recent stringent cholesterol goal of <4 mmol/L without changes in lipid lowering medications or medication dosages.

2.5.5 Pharmacological treatment for dyslipidaemia

Statin therapy (HMG-CoA reductase inhibitors) has been the mainstay of treatment for hyperlipidaemia for more than a decade (Weston et al 2005). There are however limitations to statin therapy (Shah 2003). A significant number of people are statin-intolerant due to adverse effects, the most common being gastrointestinal upset, muscle aches and hepatitis (Knopp 1999). In addition, statins can cause myalgia in approximately 3% of patients, with raised creatinine kinase (CK) enzymes and arthralgia (Zimmet and Cohen 2000). There are also a number of patients who, despite being compliant with medication and lifestyle advice, are unable to reduce their cholesterol levels (Weston et al 2005). There are now other lipid-lowering agents available, which can lower cholesterol levels, such as fibrate therapy, which lower triglycerides and increase HDL-c, or cholesterol absorption inhibitors, which work by treating cholesterol absorption in the intestine, if used alone or in combination with statin therapy (Weston et al 2005).

2.5.6 Suboptimal use of statin therapy and failure to dose-titrate lipid-lowering medication

According to Saydah et al (2004) and Oborne and Philbin (2003) current prescription rates for lipid lowering in patients with diabetes remain low, even in those with existing cardiovascular disease. Oborne and Philbin (2003) suggest that despite evidence to show that statins can reduce the risk of coronary events, it is estimated that up to 50% of patients with diabetes are currently not receiving appropriate statin therapy to lower their cholesterol. Sueta et al (1999) assessed data from 48,586 patients with coronary disease and found that only 39% of patients were receiving lipid-lowering therapy. Furthermore, a study of patients who had a history of

cardiovascular disease or diabetes mellitus found that only 19.1% of the patients were prescribed statins (Ko et al 2004). The comparison of EUROASPIRE 1 (1995-96) and 11 (1999-2000) found that there was an increase from 20.9% to 49.2% in the proportion of patients on lipid lowering medication who achieved the target goal of $\leq$ 5mmol/L. This indicates that most patients with coronary heart disease are not achieving the cholesterol goal of less than 5.0mmol/L, necessary to reduce the risk of recurrent disease and death (EUROASPIRE 1 and 11 Group 2001).

Other studies in high-risk patients have shown similar results. Fonarow et al (2001) assessed data from 138,001 patients post myocardial infarction and found that only 31.7% of patients received lipid-lowering medications at hospital discharge. Similarly, De Lusignan et al (2003) found that of 78,600 patients with CHD, only 55% were on statin therapy. Further evidence that patients with dyslipidaemia are not being treated effectively was seen in a study by Brady et al (2003), which showed only one third of patients had their dose titrated or were switched to a different statin, if they failed to reach target. An explanation for this may be found in the data from the Analysis and Understanding of Diabetes and Dyslipidaemia: Improving Treatment (AUDIT) study **(**Leiter et al 2006), a web-based survey involving 2,043 physicians specialising in the treatment of patients with type 2 diabetes mellitus. The authors reported that many diabetes specialists were not convinced of the need for lipid lowering down to current guideline targets for primary prevention of cardiovascular disease in type 2 diabetes. In addition, physicians reported that they treated patients without CVD less intensively than patients with CVD. Pearson et al (2000) observed that high doses of lipid-lowering medication were used infrequently in the L-TAP study. They suggested that the failure to achieve treatment goals despite the wide use of lipid-lowering treatment meant that either these patients were receiving inadequate treatment or the drug treatments themselves were inadequate (Pearson et al 2000). Inadequate statin dose titration may be due in part to physician and patient concerns about the safety of larger doses of statin therapy (Feldman et al 2004).

There is now firm evidence that appropriate use of statin therapy in patients with type 2 diabetes who have coronary heart disease can significantly reduce cardiovascular morbidity and mortality (Grover et al 2001, Kennedy et al 2001). Grover et al (2001)

also showed that the treatment of dyslipidaemia among diabetic patients without CVD is estimated to be as cost-effective as treatment among CVD patients without diabetes. Based on these results, the HPS (2003) suggest that statin therapy should now be considered routinely for all diabetic patients at sufficiently high risk of major vascular events, irrespective of their initial cholesterol concentrations.

2.6 Patient education and empowerment

The impact of chronic illness upon quality of life is frequently underestimated by healthcare professionals (Price 1996). In addition, health-care providers often do not adequately consider the impact of medical interventions on the patients' quality of life (Robbins 1996). The diagnosis of diabetes imposes a life-long psychological burden on the person and his / her family (IDF 2005). For some patients the diagnosis of diabetes is devastating (Meetoo and Gopaul 2005) and can lead to poor coping skills and psychological adjustment, including self blame and denial (Clark 2003). Failure to deal with this important aspect of psychological care may lead to poor self-esteem and low motivation to adopt self-care behaviour (Jacobson et al 1997). When a patient is first diagnosed with diabetes, it can be difficult to accept that they have a chronic incurable condition. They often receive a lot of information at diagnosis about their condition, the proposed management and the implications for their daily life, which can be difficult to absorb (McDonnell 2005). According to Hornsten et al (2004), studies have shown that patients may not initially accept their diagnosis, such that much of the information given to them in the early stages can be forgotten. Patients with diabetes need a lot of psychological and emotional support when first diagnosed but many will continue to rely heavily on the healthcare professional indefinitely.

Hernandez (1996) suggests that once a person decides to take control of their diabetes it is a turning point in their lives. However, it is important that the health professional realises that this decision to assume control of one's diabetes may not be permanent, but may fluctuate with changes in one's life and with the disease process itself (Paterson et al 1998). It is increasingly recognised that behavioural and psychosocial issues are critical to good diabetes management (Fisher et al 1996, Glasgow and Osteen 1992, Lorenz et al 1996). Davis et al (1988) found that behaviour outcomes were stronger predictors of mortality among diabetes patients than a host of

psychological and metabolic control measures. Depression is prevalent among people with diabetes and other chronic diseases (Lustman and Gavard 1996) and is related to both levels of self-management and clinical outcomes. Indeed, Anderson et al (2001) suggest that depression is twice as prevalent among people with diabetes, than in the general population and is often under-detected (Rubin et al 2004). It is important that depression and psychosocial issues are identified quickly, so that appropriate treatment can be given and the patients can improve their quality of life (Wilson 2004). In addition, the social and psychological circumstances of the patient must be taken into consideration, as there may be a number of issues that need to be addressed (McDonald 2006), such as fear of needles or possibly lack of family support.

2.6.1 Patient education

The concept of self-management has become integral to the care of chronic conditions in recent years and is an essential component of diabetes management (Hurley and Shea 1992, Collingsworth et al 1997). Living with diabetes is a life-long learning process for the individual. Patient education should therefore be an ongoing process, starting from the point of diagnosis and remaining as an essential component of diabetes care. In the current climate of well-informed patients who are knowledgeable and independent as a result of education, it is important that patients are encouraged and empowered to play a pro-active role in managing their disease by participating in the decision making process (Muhlhauser and Berger 2000). Diabetes education programmes which train and motivate patients to take a more active and independent role in monitoring and treating their disease are regarded as crucial to increase both the patients' quality of care and independence (Muhlhauser and Berger 1993, Berger and Muhlhauser 1999). However, despite this, many patients remain excluded from medical decisions regarding their care (Muhlhauser and Berger 2000).

Many patients are now seeking essential knowledge from non-health care sources such as the internet, friends and family, other patients, the media in addition to national diabetes organisations (O'Neill 2005). The healthcare professional's role is to help patients to acquire the knowledge and skills necessary to make well-informed choices regarding diabetes self-management (Funnell et al 1991, Anderson and Funnell 2000, Funnel and Anderson 2004). Education enables people with diabetes

to take the facts and use them properly to make decisions about how they will manage their diabetes (O'Neill 2005).

2.6.2 Empowerment

Empowerment in the context of diabetes means ensuring that a person with diabetes has sufficient knowledge, skills and understanding to make informed choices about the management of their diabetes and is responsible for the consequences of his or her actions (Hill 2003, Wilson 2004). Empowerment is about always being in control (McDonnell 2005). To facilitate patient empowerment, people with type 2 diabetes require information that is accurate and up to date, while meeting the individual needs of the person, whatever their age, culture or language (McDonnell 2005). According to Clarke (2002), the stages of change model (Prochaska and DiClemente, 1984) which looks at five stages of readiness to change behaviour, is often cyclical, with most people relapsing several times before they achieve long-term change. Importantly, relapse is incorporated as part of the process of behaviour change, rather than as failure. Hill (2003) suggests that using the stages of change model, health professionals can empower patients with diabetes to take responsibility or ownership of their health, and steer them towards making lifestyle changes, including diet and weight reduction, smoking cessation and increased exercise in addition to medication.

Although it is widely acknowledged that lifestyle and behavioural factors play an important role in the management of type 2 diabetes, patients often find it difficult to make the necessary lifestyle changes (Clarke 2002). However, not all patients with diabetes may be comfortable taking responsibility for their lives (Meeto and Gopaul 2005). Funnell et al (1991) ascertain that empowerment should acknowledge and respect a person's wish to transfer power back to the healthcare professional and that the choice remains with the patient, even when the choice is to decline power. Dealing with reluctance to lifestyle change can be challenging for the health professional. It is important to remain non-judgmental and to respect that patients have a choice and the role of the healthcare professional is to help the person with diabetes make an informed choice about their self-management (Anderson et al 1991, Miller and Rollnick 1991, King et al 2002, McDonnell 2005). Also, listening to the person with diabetes is the key to the overall success of the education process (McDonnell 2005). Information should be provided in an unbiased, non-judgmental

manner when the patient is ready to receive information as there is no point giving information if the patient is not ready to hear it (Meetoo and Gopaul 2005). Those involved in the education of patients with diabetes must realise that it can be a slow and repetitive process (McDonnell 2005).

To ensure that patients return willingly for regular review, it is vital to create an environment where the patient feels supported and encouraged, and where they are not criticised if they find it difficult to comply with recommendations (Gatling et al 1997). It is crucial that there is mutual respect between the healthcare professional and the patient (Meetoo and Gopaul 2005). Furthermore, there must be trust between the healthcare professional and the patient (Mechanic 1996). Compliance with treatment plans may improve if the patient is included as a member of the multidisciplinary team, whereby goals are negotiated and agreed upon and any concerns which the patient may have in relation to their treatment are addressed (McDonald 2006). If patients are given the opportunity to actively participate in decisions about their treatment, their self-confidence grows (Memhidir and Lundman 2004). Greenfield et al (1988) showed that encouraging patients to take an active role in their consultations with doctors could bring about a reduction in HbA1c of more than 1%. This reduction came at a cost of an average 3 additional minutes of consultation time (Greenfield et al 1988). Street et al (1993) found in a study involving 47 patients with Type 2 diabetes, that patient-centred consultation, where the patient's opinion was respected and they were involved in the decision making about their care, improved metabolic control. However, this information has not been taken on board in many diabetes clinics and patients are still not actively involved in their diabetes care (Burden and Burden 2001).

2.6.3 Compliance / adherence with treatment

Compliance has negative connotations (Vermeire et al 2006), whereas the term adherence is meant to be non-judgmental, a statement of fact (Clark 2004). For patients with chronic diseases such as hypertension (Vaur et al 1999, Munger et al 2007) and type 2 diabetes (Paes et al 1997, Donnan et al 2002, Evans et al 2002, Schectman et al 2002, Clark 2004), medication non-adherence remains a significant concern for healthcare professionals and patients (Munger et al 2007). Poor adherence to medication regimes contributes to substantial worsening of disease,

death and increased health care costs (Osterberg and Blaschke 2005), imposing a considerable financial burden upon healthcare systems (Vermeire et al 2006). On average, one third to half of patients do not comply with their treatment regimens (Dunbar-Jacob et al 2000, LaFleur and Oderda 2004, Osterberg and Blaschke 2005) and between one third and two thirds of all medication-related hospital admissions are related to non-adherence (Senst et al 2001, McDonnell and Jacobs 2002).

Compliance has been defined as the extent to which a person's behaviour in terms of taking medication correctly, following diets and making lifestyle changes, coincided with medical or health advice. However, there are also other forms of non-compliance such as delay in seeking care, breaking appointments and failure to follow health professionals' advice, not filling a new prescription, forgetting doses of medication, taking medication incorrectly or stopping treatment (Vermeire et al 2006). Many factors are responsible for poor compliance (Guillausseau 2004), some of which are not modifiable, such as age, severe complications and disabilities, in addition to social, educational and financial difficulties (Schectman et al 2002, Guillausseau 2003). Patient compliance with oral hypoglycaemic agents is often sub-optimal (Brennan et al 1998), which can have a negative impact on their glycaemic control (Browne et al 2000). A study by Donnan et al (2002) in 2920 patients with type 2 diabetes, suggested that poor compliance with medication is a major problem in the treatment of diabetes, as only one in three patients adhere to their oral hypoglycaemic agents. Guillausseau (2004) reported on a six month study involving 4,802 patients with type 2 diabetes. The study aimed to evaluate the impact of optimization of treatment for patients with diabetes, by changing to monotherapy whenever possible or switching from multiple daily dosing to once-daily preparations, on patient compliance with therapy. Patients were reviewed by their GP before and after the intervention. The results indicated that compliance with oral hypoglycaemic agents increased from 44% (multiple daily medications) to 69.5% after switching to monotherapy if possible or changing from multiple daily dosing of medication to a once-daily preparation, in addition to educating patients on problems associated with non compliance. As a result of this increase in compliance, metabolic control also significantly improved, as seen by a reduction in HbA1c levels.

Balazovheck and Hnilica (1993) suggest that knowledge about hypertension influences compliance. Although randomized trials have shown that treating high blood pressure reduces the risk of heart attacks and strokes (Staessen et al 2001), control of blood pressure in general practice is not optimal **(**Colhoun et al 1998) and lack of adherence to medication is a common reason quoted (Sackett et al 1975, Ebrahim 1998, Benson and Britten 2002). A recent survey of UK health care professionals cited 'poor compliance' as the most important factor in people developing diabetic complications (Omar 2003). The World Health Organisation (2002) has recognised the importance of improving adherence to medication, as adherence to treatment is a complex health behaviour and non-adherence can be costly to the individual involved in terms of possible complications and to the healthcare system as a whole (Clark 2004). Ebrahim (1998) suggested that medication adherence in hypertension is estimated to be only around 50% - 70%.

2.6.4 Lack of knowledge regarding diabetes management among both patients and healthcare professionals

Studies have demonstrated a notable lack of knowledge regarding diabetes medication among both patients and healthcare professionals (Wamae and de Costa 1999**,** Browne et al 2000). Poor compliance may result from patients' lack of understanding of how the tablet works, or the importance of taking their oral hypoglycaemic agents, or due to having side-effects (Browne et al 2000). Also, possible lack of knowledge on the part of the health professional regarding medication and their use and side effects, is possibly a contributing factor in why patients are not compliant with medication, as the healthcare professional needs to update the patient on a regular basis about the importance of adherence to medication. Where diabetes medications are concerned, their action, any possibly side-effects, and storage should be explained in a style that is readily understood by the person with diabetes (Meetoo and Gopaul 2005).

A study by Browne et al (2000) to assess knowledge about oral hypoglycaemic agents amongst 261 patients with type 2 diabetes and 102 healthcare professionals, concluded that patients' and healthcare professionals' knowledge of oral hypoglycaemic agents is poor. Only 15% of patients with diabetes knew the correct action of oral hypoglycaemic agents, only 10% of those taking a sulphonylureas knew

that it may cause low blood sugars and 20% of those taking Metformin knew that it could have gastrointestinal side-effects. Only 35% of patients recalled receiving advice about their medication and only 1% receiving written advice. In addition, there were significant knowledge deficits in the non-specialist healthcare professionals regarding dosage, timing and mechanisms of medication, particularly the action of Metformin and Acarbose. Dunning and Manias (2005) demonstrated that 93% of patients in their study were informed about how and when to take their oral hypoglycaemic agents, however, only 37% were given information about side effects. More recently, Williams et al (2007) in a study of 51 patients, reported that only 35% of patients indicated that they were given written information regarding their medication, and only 18% indicated that they had been told side effects relating to the medication they were taking.

Holstein et al (2000**)** found that in a group of final year medical students, physiology knowledge was good but that knowledge of diet and the practical aspects of diabetes management were poor. Only 18% recognised that only insulin and sulphonylureas could cause hypoglycaemia, whilst Metformin and Acarbose could not. While a study to determine the level of diabetes knowledge among registered nurses in a UK teaching hospital, found that 95.8% answered questions on oral hypoglycaemic agents incorrectly and only 49.5% could identify the side-effects of these drugs (Findlow and McDowell 2002). This lack of knowledge regarding diabetes medication among medical students and qualified nursing staff raises concern, as Vermeire et al (2003) suggests that the content and consistency of information given to individuals influences their adherence to treatment regimes. For this reason, Diabetes UK (2001) suggests that people with diabetes should be cared for by health professionals who have a comprehensive understanding of diabetes.

According to Glasgow (1997) one needs to ascertain whether patients understand recommendations from their health care providers and whether they are receiving consistent messages from all team members. A study by Parkin and Skinner (2003) to explore the degree of agreement between patient and health care professional's perceptions of consultation in 141 patients, found that patients and professionals disagreed on the issues discussed 19.6% of the time, on the decisions made 20.7%

of the time and goals set 44.3% of the time. This would indicate that one can not assume that once information has been given to a patient that it has been understood and will be remembered by the patient (Asimakopoulou 2007). Muhlhauser and Berger (2000) emphasise the importance of informed patient choice and involving patients in the decision making process. According to Muhlhauser and Berger (2002), evidence-based patient choice, rests upon providing people with research-based information about the effectiveness of healthcare options in an unbiased way, in a format that can be understood by non-medically trained persons (Coulter 1998, Bogardus et al 1999). It is important to try and develop individualised plans and goals with patients, whereby one takes into account both the patients' perspective and the social environment in which they are managing their diabetes.

2.7 Nurse-led clinics

A review of nurse-led services in Ireland was carried out by The National Council for the Professional Development of Nursing and Midwifery (2005) using the following definition for nurse-led care:

> "Nurse led care is provided by nurses responsible for case management which includes patient assessment, developing implementing and managing a plan of care, clinical leadership and decision to admit and discharge. Patients are referred to nurse-led services in accordance with collaboratively agreed protocols". Pg 7.

They found that 24% of nurse-led services were in the community setting, 39% were in the hospital setting and 27% were in both hospital and community setting. Nurse-led clinics have evolved in response to a need or gap in the service and have many facets such as, providing health education and health promotion, reducing waiting times in clinics by assessing patient needs and planning appropriate patient centred care and providing continuity of care (McDonald 2006). McDonald (2006) suggests that for a nurse-led clinic to be successful there must be a desire for change, a clear idea of how a service can be improved, and in addition, the nurse's role must be defined and relevant education provided.

It has been shown that nurse-led clinics in both primary and secondary care can reduce total mortality in patients with coronary heart disease (Campbell et al 1998, Cupples and McKnight 1999, Moher et al 2001, Allen et al 2002, Murchie et al 2003). Allen et al (2002) studied 228 adults post coronary revascularization, who were randomized to receive lipid management from a nurse practitioner in addition to their usual care, or to usual care enhanced with feedback on lipids to patient's primary healthcare provider and or cardiologist. They found that control of dyslipidaemia can be improved by a nurse case-management programme. More patients in the nurse led group achieved LDL-c targets (65% vs 35%). Similarly Becker et al (1998) evaluated management strategies for LDL-c levels in siblings of individuals with documented coronary heart disease, with care either provided by a nurse trained in lipid management or physicians in primary care who received recommendations based on national guidelines. Results showed that trained nurses were more likely than primary care physicians to achieve LDL-c targets (26% v 10%). Individuals taking lipid-lowering drug treatment were more likely to achieve LDL-c goals but nurses were more likely to initiate treatment (45.2% v 16.7%).

Diabetes specialist nurses in many parts of the UK manage their own caseload, initiating and titrating drugs for glycaemic control, but have little input or experience in managing other cardiovascular risk factors (Aubert et al 1998, New et al 2003). A study by Davidson (2003) involving Hispanic and African American patients in Los Angeles concluded that specially trained nurses who follow detailed protocols and algorithms under the supervision of a diabetologist could markedly improve diabetes outcomes in a minority population, especially a reduction in HbA1c. However, their role in the management of hypertension and cardiovascular risk reduction is not as well recognised (Woodward et al 2006). A number of trials (Denver et al 2003, New et al 2003, Davidson 2003, New et al 2004, Woodward et al 2005, Woodward et al 2006, McLoughney et al 2007), have looked at the benefits of nurse-led care in patients with diabetes. These will be discussed in the subsequent sections.

2.7.1 Nurse-led management of blood pressure

A study by Logan et al (1979), involving 457 patients, compared treatment of blood pressure by specially trained nurses at the patient's work place versus management by the family doctor. Results indicated that patients in the nurse led group were more

likely to be put on antihypertensive medication (94.7% v 62.7%), to reach goal blood pressure in the first six months (48.5% v 27.5%) and to take the drugs prescribed (67.6% v 49.1%). While Woollard et al (2003) examined 212 patients who were at increased risk of cardiovascular disease, as a result of pre-existing risk factors, such as hypertension, diabetes or coronary disease. They examined whether lifestyle programmes delivered by nurse counsellors in a primary care setting could lower blood pressure among these at-risk patients. There were three groups, a control group receiving usual care, a low group who had one individual counselling session then monthly telephone contact for 1 year and a high group with individual counselling up to 1 hour monthly for 1 year. Results showed that after 18 months, despite lifestyle programmes by nurse counsellors, targets for BP control were not met in about 60% of patients and almost 50% of patients had clinic blood pressure above 140/90 mmHg. This would suggest that on-going up to date physician and nursing education on blood pressure targets is required.

Denver et al (2003) compared the effectiveness of a nurse-led hypertension clinic with conventional community care in general practice in management of uncontrolled hypertension in type 2 diabetes in UK. They studied 120 patients for a period of 6 months, with a BP target of < 140/80 mmHg. Patients were allocated to conventional primary care or a nurse-led hypertension clinic. Patients in the nurse-led group were seen monthly for 3 months, and then every 6 weeks for a further 3 months. Patients were given non-pharmacological advice for healthy living, in addition to the nurse initiating treatment changes, i.e. existing drugs were titrated or a new drug added to therapy in consultation with a doctor. The study concluded that a nurse-led hypertension clinic is a more effective intervention than conventional care, for patients with type 2 diabetes and uncontrolled hypertension. Patients in the nurse-led groups were nearly six times more likely to have their treatment regimen adjusted compared with those in conventional care and this rigorous application of the guidelines in the context of nurse-led management appears to be the key to greater improvement.

Two studies by Woodward et al (2005 and 2006) studied 110 patients with type 2 diabetes who were referred to a nurse-led clinic where the focus was on cardiovascular risk reduction and optimizing blood pressure. Time allocated for the

first visit was 45 minutes and subsequent visits were 20 minutes. Patients were advised about lifestyle changes, the benefits of antihypertensive agents, side effects as well as BP targets and future management and there was no intervention to improve glycaemic control. Once optimal BP control was achieved on two consecutive visits and cardiovascular risk factors had been addressed, patients were referred to their GP for routine BP surveillance and their clinical and biochemical data was reviewed 9 months later. The intended target blood pressure was $\leq$140/85 mmHg. At the review visit 79% patients were at or below the target level, with a mean BP of 133/67mmHg.

2.7.2 Nurse-led management of glycaemic control

The results of the study by Woodward et al (2005) mentioned previously, showed an unexpected improvement in glycaemic control despite the fact that glycaemic interventions were not part of the study protocol. However, more patients in the non-intervention group achieved a target of $\leq$ 7% (38%) compared with 16% of patients in the intervention group. This was probably due to the fact that during the study, if patients expressed a need to discuss glycaemic control, they were referred to a diabetes specialist nurse in the routine outpatients clinic, where modification in their therapy could be made, such as changes in doses of oral hypoglycaemic agents or insulin, or possibly the addition of another oral hypoglycaemic agent. This study suggests that whatever the therapeutic intervention, patients benefit from regular contact with health professionals (Woodward et al 2005). In addition, a protocol-driven nurse-led clinic using an open clinical algorithm can be used effectively to manage cardiovascular risk reduction in Type 2 diabetes (Woodward et al 2006).

2.7.3 Nurse-led management of both blood pressure and dyslipidaemia

The SPecialised nurse-Led INTervention to treat and control hypertension and hyperlipidaemia in diabetes (SPLINT) study (New et al 2003) studied 1,407 subjects who were all receiving shared care between hospital and GP. Individuals were randomised to usual care (shared care approach with primary care (GP-led) management in addition to annual review by secondary care physician) or usual care with subsequent invitation to attend specialist nurse led hypertension or hyperlipidaemia clinics. Patients with both conditions were eligible to attend either or both clinics. Separate specialist nurses provided each intervention. Patients were seen every 4-6 weeks until targets were achieved. Appointment times averaged 30 -

45 minutes. Targets aimed for were BP <140/80 and total cholesterol <5.0mmol/l. At each visit lifestyle issues were addressed and the dose of antihypertensive and cholesterol-lowering medication were titrated by the specialist nurse in a stepped care approach in accordance with protocols agreed on by the local Drugs and Therapeutic Committee. If patients required additional medication outside the agreed protocol, this was agreed and ordered by the doctor. More patients with hyperlipidaemia who attended the nurse-led clinic reached target (53% v 40%). Both groups were similar with regard to reaching blood pressure (27% v 24%). This study provided good evidence to support the use of specialist nurse-led clinics for hypertension and hyperlipidaemia provided for diabetes patients, in addition to hospital-based care of patients with diabetes. An economic analysis of the SPLINT trial was carried out by Mason et al (2005) which concluded that specialist nurse-led clinics are likely to be cost-effective as adjunctive care lowering blood pressure and cholesterol in hospital-based management of diabetes. It was suggested that it would be more cost effective if one specialist nurse provided a holistic programme of lifestyle intervention, to manage blood pressure, glycaemia and lipid control.

However, a trial run in primary care, Education outreach in Diabetes to Encourage practice Nurses (EDEN), whereby practices were randomized to receive educational outreach visits by specialist nurses either for hyperlipidaemia or hypertension intervention (New et al 2004), found that specialist nurses in primary care were not an effective means of improving blood pressure or lipid targets. Target blood pressure was <140/80 mmHg and total cholesterol <5.0 mmol/l. The outreach nurse explained the intervention targets, and how to manage treatment. A flow sheet was given to each practice regarding primary care hypertension and hyperlipidaemia guidelines. Each practice nurse was given a list of patients who were above target at their last visit and the aim was to intervene to achieve targets. Every 3 months the outreach nurse visited practices to provide support and encouragement. New et al noted that while many practice nurses recalled patients failing to achieve target blood pressure and cholesterol and wanted to modify therapy, they found their general practitioners (GP) reluctant to alter the patient's treatment. This caused confusion among the patients and some difficulties between the practice nurse and the GP. The biggest hurdle was seen as lack of resources to implement this type of intervention in primary

care and poor communication between practice nurses who saw the patients and GP's who had to approve medication changes.

2.7.4 Nurse-led management of cardiovascular risk factors

A study by Taylor et al (2003), involving 169 patients, randomised patients to usual care with their primary care physician or a special intervention group where patients met with a nurse to establish individual goals, attended group sessions once a week for up to 4 weeks and received telephone calls to manage medications and self-care activities. The time allocated for the initial consultation with the patient was 90 minutes, telephone calls during the study were on average 15 minutes every 4 – 8 weeks during the study and patients attended 1 – 2 hour group sessions once a week for 4 weeks. The study demonstrated that a nurse-led programme for management of patients with complicated diabetes and other chronic conditions, significantly improved HbA1c levels and total and LDL cholesterol, with no increase in physician visits. There were additional costs for providing the intervention, including the cost of the nurse-care manager, the additional medication, laboratory costs incurred by using the management algorithms and costs related to higher rates of routine assessment and self-management.

Campbell et al (1998) studied 1343 patients who were offered regular follow up of medical care and lifestyle intervention over a period of one year, to evaluate whether nurse run clinics in general practice would improve secondary prevention in patients with coronary heart disease. They found that it could but a significant time input was required, the initial clinic visit ranged from 30-60 minutes and subsequent visits ranged from 10-30 minutes. Therefore, to achieve positive results on cardiovascular risk factors, nursing interventions need to be intensive and frequent. It also requires a significant time commitment both for the health care professional and patient (Riley 2003**).** A follow up of the nurse led clinic by Campbell et al (1998) by the use of questionnaire and reviewing notes, showed that nurse led secondary prevention improved medical and lifestyle aspects of secondary prevention with a trend toward fewer coronary events and suggested that secondary prevention clinics should be started sooner (Munchie et al 2003).

More recently a study by McLoughney et al (2007) aimed to evaluate the effectiveness of a specialist nurse-led, protocol-driven and doctor-supervised clinic in the management of cardiovascular risk factors, especially hypertension and dyslipidaemia in 94 patients with type 2 diabetes. On average each patient was reviewed three times in the nurse-led clinic but the frequency of follow-up was determined by clinical circumstances. The first visit took 45 – 60 minutes and follow up visits were 30 minutes. Target blood pressure was < 140/80 mmHg or < 130/75 mmHg if a patient had renal impairment. Once patients achieved targets they were discharged from the clinic. Results indicated that of those patients with hypertension, 94% achieved target BP. However, the paper does not state whether 94% achieved both systolic and diastolic targets, or whether the patients achieved target in either systolic or diastolic blood pressure. Also of those patients with dyslipidaemia, 91% achieved target lipid profiles, however, it is not clear if all 91% achieved one or all lipid targets. Only 45% of patients achieved target HbA1c of < 7%. The results were significant and this study concludes that specialist nurse-led clinics can be effective in improving blood pressure and lipid profiles in patients with type 2 diabetes.

2.7.5 Communication

A study conducted by Aminoff and Kjellgren (2001) studied the content of communication between the patients and nurse at follow up appointments relating to hypertension. Consultations with nurses varied between 5 and 50 minutes, with an average of 18 minutes. The nurses discussed lifestyle interventions with patients, also cardiovascular risk factors and adherence to treatment. One of the common topics introduced by patients was to clarify what was said to them by the physician in their earlier consultation. Patients played an active role in the consultation. In a study conducted by Kjellgren et al (2000) to explore the structure and content of communication between the patients and physician, consultations with physicians averaged 14 minutes where patients' questions mainly referred to side effects of their medication. The physician dominated the interaction whereas the patients played a more passive role in the consultation. Little time was spent discussing the risks related to hypertension. This would possibly indicate that physicians and nurses have different roles when treating patients with hypertension. The physician sets the goals and prescribes the treatment, whereas, the nurse plays an important role in

hypertension management, by educating the patient on lifestyle changes (Aminoff and Kjellgren 2001).

Andresson and Mattsson (1994) argued that good consultations depend on the healthcare provider and not on the length of the consultation. The benefits of behavioural counselling by nurses, has been shown to change health behaviour in patients at increased risk of coronary heart disease (Lip and Beevrs 1997, Steptoe et al 1999, Ramsey et al 1999). Pierce et al (2000) noted that practice nurses now undertake chronic disease management that was previously carried out by GPs in the UK. Recent studies (Audit Commission 2000**,** Kenny et al 2002, Williams et al 2002) suggest that annual diabetic reviews are carried out by practice nurses alone in 32-42% of primary care practices. In fact a study by Stewart et al (2005a) demonstrated that in 46% of GP practices, many annual diabetes reviews for patients with type 2 diabetes, are carried out solely by the practice nurse for some if not all patients with type 2 diabetes.

According to Gupta (2000), practice nurses' work has moved more towards that of health promoter, which includes the giving of information along with support to the individual and facilitating change (Katz and Peberdy 1997). Stewart et al (2006) reported on a qualitative study, which used semi-structured interviews, to explore practice nurses' attitudes and beliefs toward health promotion in relation to diabetes. The results showed that practice nurses perceived the main barrier to achieving blood pressure targets in type 2 diabetes were patient's lack of understanding of how important it is to control one's blood pressure, in addition to lack of adherence to lifestyle advice or to prescribed medication. This may be also associated with lack of understanding about diabetes and its management. Lack of time was also an issue, not just in relation to delivering patient-centred care but also in terms of communication between doctors and nurses. Nurses were not always involved in the process of making decisions on the management of blood pressure. They perceived their role to be checking and reporting raised blood pressure, rather than directly responding to it.

On reviewing the literature, in all nurse led intervention studies where blood pressure targets were mentioned, they were less stringent than those recommended by the

more recent recommendations, (ADA 2005, Chobanian et al 2003, European Society of Hypertension 2003), who suggest a target Blood pressure of <130/80 mmHg in patients with diabetes. Also, one nurse did not address all cardiovascular risk factors, therefore there was no continuity of care, which can play a vital role in patient care.

2.8 Knowledge of vascular risk factors and diabetes

Knowledge of vascular risk factors is important so that patients can make lifestyle changes which may prevent, or delay microvascular and macrovascular complications. A review of the literature revealed that there are trends across the world showing knowledge of heart disease and its relationship to diabetes, knowledge of blood pressure and cholesterol, to be inadequate (Ali et al 1998, Jabbar et al 2001, Bairey Merz et al 2002, Latalski et al 2002, Alexander et al 2003, Cheng et al 2005a, Cheng et al 2005b, Adil et al 2005, Mohan et al 2005, Petrella and Campbell 2005, Jafary et al 2005 and Wagner et al 2005). Little is known about patients understanding of blood pressure (Stewart et al 2005) or patient awareness of nationally recommended blood pressure targets (Cheng et al 2005b). In addition, systolic blood pressure is a strong independent risk factor for cardiovascular disease but no information is available on whether patients understand the importance of their SBP level (Hansson et al 1998, O'Donnell and Kannel 1998, Perry et al 2000, Izzo et al 2000, Oliveria et al 2005). A study carried out by Cheng et al (2005b) found that of 738 patients interviewed, 50% could correctly name the target for total cholesterol, 5% target LDL-c and 2% target HDL-c. Only 48.9% of all patients could correctly name targets for systolic or diastolic blood pressure values and knowledge of target blood pressure levels was particularly low among females, aged $\geq$ 60 years. In addition, having a major risk factor such as diabetes did not enhance patients' knowledge of their blood pressure or recommended targets suggesting that current blood pressure education is inadequate especially for those at high risk.

Oliveria et al (2005) found that of 826 patients studied who had hypertension, 90% knew that lowering blood pressure would improve health, 24% did not know the optimal level for either SBD or DBP and 35% of this group of hypertensive patients did not consider high blood pressure as a serious health concern. A study by Potvin et al (2000) which examined the ability of 23,129 respondents to recall cardiovascular disease risk factors, found that more people were aware that certain behaviours such

as fat in diet, smoking and lack of exercise were risk factors for CVD, but were less aware that weight, cholesterol and high blood pressure were risk factors for cardiovascular disease. They also found that people at higher risk of CVD, such as those over 65 years or those with poor education, were less able to recall important cardiovascular disease risk factors.

A telephone survey reported by Petrella and Campbell (2005), showed that of respondents diagnosed with hypertension, only 44% were able to identify their own blood pressure or what would constitute above or below recommended targets. Also 80% were unaware of the association between hypertension and heart disease. Almost two-thirds (63%) thought hypertension had clearly identifiable signs or symptoms, although they believed that hypertension was not a serious medical condition. Most respondents (59%) believed that they would not develop hypertension and 38% thought they would be able to control hypertension without the aid of a physician. The majority of respondents were unaware of the association between hypertension and heart disease, heart attack, kidney disease, damage to blood vessels and premature death. Ali et al (1998) in a study to determine the level of health education in 712 people with diabetes, found that 77% of the study population had no knowledge of diabetes and its complications. While Latalski et al (2002) in a study evaluating the level of knowledge of 130 patients with diabetes by means of a questionnaire, found that only 6.1% of patients felt their knowledge of diabetes was very good, 53.1% said good, which means that 40.8% of patients considered their level of knowledge to be unsatisfactory.

Prior to an initiative to increase public awareness of CVD and diabetes, the ADA and the American College of Cardiology conducted an online survey of 900 physicians and a telephone survey of 2,008 people with diabetes to determine how much they knew about the increased risk of CVD associated with diabetes (Bairey Merz et al 2002). They found that 68% of people with diabetes did not consider cardiovascular disease to be a serious complication of diabetes. People with diabetes surveyed were more likely to be aware of diabetes complications causing disability, such as blindness and amputation rather than complications that may result in premature death such as heart disease, heart attack or stroke. Few people surveyed appeared to have insight into how they could reduce their risk of heart attack or stroke, by way of

medication, lowering cholesterol, quitting smoking, reducing blood pressure and taking aspirin.

The physicians when asked to rank the highest treatment priority for reducing CVD risk in their patients with diabetes, 63% ranked lowering of blood glucose as the highest treatment priority, with only 22% indicating blood pressure and only 7% identifying cholesterol management as the highest priority. This is despite a high level of awareness among physicians about the CVD risks associated with diabetes. Physicians perceived poor compliance with behavioural modifications and medication regimes to be the greatest barrier to management of cardiovascular disease risks in their diabetic patients (Bairey Merz et al 2002). This is different from the AUDIT study mentioned previously (Leiter et al 2006) where 32% of physicians believed that blood pressure would have the greatest impact on reducing CVD, followed by lipid management (28%) and glycaemic control (22%). When setting lipid targets, physicians were influenced by published lipid management guidelines, however less than 70% of patients were estimated to be at the target LDL-c of 2.6 mmol/L, highlighting the under treatment of dyslipidaemia in patients with type 2 diabetes. This poll suggested a serious lack of knowledge of heart disease and its risk to patients with diabetes.

In their study, Jafary et al (2005) found that approximately 20% of patients could not identify a single risk factor for coronary heart disease. While a study by Jabbar et al (2001), to determine the standard of knowledge among 230 patients with diabetes, found that only 60% of patients were aware of target blood glucose levels for optimal control and emphasised the need for diabetes education for both patients and healthcare providers. In a study of 26,001 patients to assess the awareness of diabetes in an urban south Indian population in Chennai (the Chennai Urban and Rural Epidemiology Study (CURES), using structured questionnaires, nearly 25% of the population were unaware of a condition called diabetes (Mohan et al 2005). In addition, only 19% of the total population knew that diabetes could cause complications, and even among those with diabetes, only 40.6% of patients were aware that diabetes could cause complications. This indicated that awareness and knowledge regarding diabetes was poor in India and diabetes education programmes were urgently required both in urban and rural India (Mohan et al 2005). As a result

of the findings of the CURES a diabetes awareness and screening programme, the Prevention Awareness Counselling and Evaluation diabetes programme (PACE) was launched in Chennai (Suresh et al 2005), involving awareness programmes on a daily basis in schools and public places, camps for children, diabetes education materials, posters, CD's, a documentary was telecast on local TV and radio, screening for diabetes and its complications in addition to professional training for GPs. Rachmani et al (2002) carried out a prospective study of 165 patients with the aim of ascertaining whether sharing the therapeutic responsibility with the patients would improve their outcomes. Patients were randomly allocated to a standard annual consultation or a patient participation and teaching programme, whereby patients in the patients participation programme were given two 2 hour individual educations sessions about ways to achieve control of modifiable risk factors and goals to aim for; they were also advised to measure their blood pressure and discuss treatment with their consultant. The study concluded that well-informed and motivated patients were more inclined to reach and maintain target values of the main risk factors of diabetic complications. A prospective 8 years follow up of the study (Rachmani et al 2005) also found that well-informed and motivated patients were more successful in maintaining good control of their risk factors, resulting in reduced cardiovascular risk and slower progression of microvascular disease, possibly as a result of intensified therapy and by better compliance. Furthermore, Tham et al (2004), found that diabetes education resulted in better-informed patients with diabetes and changed behaviour, but 25% of patients in the study were ignorant of some key aspects, such as the need for home blood glucose monitoring. A survey by Diabetes UK (2002) showed that less than 20% of people with diabetes knew about their increased risk of heart disease. Active patient participation in their care is a critical factor in improving adherence to treatment (Aminoff and Kjellgren 2001).

Market Research on 'Evaluation of Attitudes to High Blood Pressure' was carried out on a sample of 1000 participants in the Dublin region in 2006 to coincide with the launch of Irish Heart Week (Irish Heart Foundation 2006). It found that 45% of people aged 50-64 years surveyed were unable to estimate what a normal blood pressure reading should be. There was a high level of awareness of the factors contributing to high blood pressure with 85-95% identifying weight as a problem, in addition, 92% were aware that heart attacks and strokes could be caused by high

blood pressure. This shows a high knowledge of risk of heart attack and stroke rising from high blood pressure, however despite the fact that a high percentage of patients interviewed may have hypertension, even if unaware of same, not many patients were able to identify targets in this general Irish population. Stewart et al (2005b) found that some participants were aware of targets but felt that people should have individual targets not one generic target. The respondents also felt that health professionals did not appear to understand how difficult it was to maintain lifestyle changes.

2.9 Summary of literature review and research aim

Type 2 diabetes is not just about blood glucose, but it is a constellation of risk factors, namely, hypertension, dyslipidaemia and glycaemic control, which predispose to premature death. The ADA (2008) recommend aggressive treatment of these cardiovascular risk factors, with more stringent target levels for lipids and blood pressure than those recommended for the general population. However, in the real world, as evidenced by extent of patients not achieving recommended vascular risk targets, it is difficult to achieve these vascular risk targets, particularly with regard to hypertension. This is due to a number of reasons, including, ever increasing number of patients with diabetes, time constraints, funding, and lack of education. In many centres in Ireland, patients are typically seen on an annual basis and therefore aggressive vascular risk reduction is not possible. The diabetes nurse specialist plays a vital role in the management of the patient with diabetes. They are often the first person a patient will meet in the multidisciplinary diabetes team. Education is given on all aspects and management of diabetes care, by the diabetes nurse specialist, who is educated to a Higher Diploma Level and has more knowledge regarding diabetes care than the general staff nurse. Therefore, the aim of this research study was to determine whether an intensive, nurse-led clinic could achieve recommended vascular risk reduction targets in patients with type 2 diabetes compared with standard diabetes management. This study differs from previous nurse-led studies (Denver et al 2003, New et al 2003) in that it was exclusively hospital based, one nurse managed all aspects of multi-intervention and the targets aimed for were more stringent than many previous studies.

Assessment of knowledge is important in clinical care of patients with diabetes, so that education can be tailored to meet individual patients needs (Wagner et al 2005). Due to the many patients with diabetes having at least one cardiovascular risk factor, i.e.- hypertension, dyslipidaemia or previously diagnosed macrovascular disease, the study also aimed to determine the extent of knowledge patients had regarding vascular risk factors. For the purpose of this study, a questionnaire was designed as a data collection instrument (Oliveria et al 2005), to assess and document retention of knowledge with regard to patient knowledge of and attitudes towards, diabetes, vascular risk factor targets and heart disease between the standard and intensive groups.

Chapter 3

Research Methodology

3.1 Introduction

The review of the literature undertaken in chapter one and two highlights the extent of evidence-based information on the area of type 2 diabetes mellitus, vascular risk factors, (hypertension, dyslipidaemia, glycaemic control), in addition to the whole area of patient knowledge, education and patient empowerment. The following chapter is divided into two parts.

Part 1 - Nurse-led randomized controlled trial involving patients in an acute care setting

Part 2 - Questionnaire to determine patient knowledge of diabetes and its association with vascular risks

3.2 Part 1 - Randomized controlled trial

Part 1 of the study was designed to test the hypothesis that an intensive nurse-led vascular risk reduction clinic could impact on vascular risk factors in type 2 diabetes, when compared with standard annual review in the diabetes outpatient clinic. Biochemical data was collected and analysed and interventions during the study were recorded.

Targets being aimed for were as per ADA (2001) guidelines

- BP ≤ 130/80 mmHg
- Total cholesterol ≤ 4.8mmol/L
- LDL ≤ 2.6 mmol/L
- HBA1c ≤ 6.5%
- HDL cholesterol > 1 mmol/L
- Triglycerides < 1.9 mmol/L.

In addition, aspirin prescribing and smoking status were recorded. Care given was hospital based, in an Irish setting with one nurse providing the care for hyperglycaemia, hypertension and hyperlipidaemia.

3.2.1 Study design

The study was a randomised controlled trial of patients with type 2 diabetes mellitus and compared standard management of cardiovascular risk factors (yearly OPD review) versus intensive management which was nurse-led, in addition to standard management.

3.2.2 Sample

Two hundred patients with type 2 diabetes mellitus were recruited from the diabetes service in Beaumont Hospital using the following criteria:-

Inclusion criteria:–

- Have Type 2 Diabetes Mellitus:
- Over 30 years of age;
- Able to give informed consent;
- Be diet controlled, on oral hypoglycaemic agents or, treated with oral hypoglycaemic agents for at least 1 year prior to commencing insulin.
- Patients also had to have at least one further cardiovascular risk factor, i.e.-
  - Hypertension (BP > 130/80 mmHg or on anti-hypertensive medication);
  - Dyslipidaemia (total cholesterol > 4.8 mmol/1; LDL-c > 2.6 mmol/1 or on lipid-lowering therapy);
  - Be a smoker;
  - Have persistent microalbuminuria;
  - Or have previously diagnosed macrovascular disease.

Exclusion criteria:–

- No other risk factors for cardiovascular disease, apart from type 2 diabetes mellitus;
- Impaired glucose tolerance;
- Under 30 years of age;
- Unable to give informed consent or participating in any other research study.

3.2.3 Recruitment and Randomisation

A poster regarding the study was placed in the OPD and diabetes centre (Appendix 3). Eligible patients were identified by examination of medical charts. Patients were then recruited in either the diabetes day centre when they attended for pre clinic visit, by letter (Appendix 4), or at the outpatient clinic. Patients were randomised to either intensive (n=101) or standard (n=99) groups by the use of standard randomisation tables, in order to eliminate bias. Randomisation was defined as the date the patient presented for their first visit, in addition to the last digit of their hospital number. Patients were followed up for a period of 1 year. A letter was sent informing the patient's GP of their inclusion in the study.

Patients who were on antihypertensive medication prior to commencing the study continued on this medication. During the study, patients with uncontrolled hypertension commenced on Perindopril (unless contraindicated) which was titrated to maximum dose, if tolerated. If their BP remained uncontrolled or if the patient developed side effects to the ACE inhibitor, patients were commenced on another agent. The addition of additional BP agents was made based on the patient's blood pressure control and chosen in consultation with the medical team.

<u>Standard Group</u>

Patients in the standard group received standard diabetes treatment, involving a yearly review, by a member of the diabetes team, in the OPD clinic at Beaumont hospital ± visits with their GP. They were seen at the beginning and the end of the study by the vascular intervention nurse. They received general diabetes advice but did not receive advice on vascular risks or changes in management and did not receive any feedback on their visit. If any changes in therapy were made during the study by the patient's GP, these were recorded as an intervention.

<u>Intensive Group</u>

Patients in the intensive group continued to receive standard annual review in the OPD clinic. They were seen by the vascular intervention nurse every 2-3 months. At each visit, risk factors were monitored. Patients were given individual verbal and written advice on lifestyle modifications, such as diet, weight reduction, exercise, alcohol consumption and smoking cessation and lifestyle advice was reinforced.

Patients received feedback on their visit and whether they were achieving the desired vascular risk targets. In order to achieve pre-designated targets, medications were titrated in response to BP and biochemical results following each visit. A letter was sent to the patient and GP informing them of any changes in treatment.

At each visit in both groups, blood samples were drawn for measurements of total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, glycosylated haemoglobin (HbA_1C), liver transaminases (LFT's) and renal function (U & E). A random urine sample was collected to measure urinary albumin excretion. Blood pressure was measured, with patient in sitting position for 15 minutes, using an automated blood pressure device (OMRON 705 CP). Three consecutive blood pressure readings were taken, and the average reading was recorded. A twelve lead ECG was recorded at the beginning and end of the study. In addition, smoking status was noted. Current medications were reviewed and any changes made in therapy since last visit, were recorded**.**

3.2.4 Ethics

All information collected during this study is strictly confidential, in accordance with data protection laws. The study was approved by the ethics section of Beaumont Hospital Medical Research Committee. The purpose of the study was explained to patients who were eligible for the study. They were provided with written information on the background to the study (Appendix 5). Patients were given information regarding the possible side effects of medication being used during the study and were advised that the medication used in the study was not trial medication, but was used in normal practice by the medical profession. Patients who agreed to participate in the study signed a consent form (Appendix 6). Patients were given a seven day cooling off period, whereby if they decided not to participate in the study, they could change their mind without affecting their future diabetes management. In addition, patients were advised that they could withdraw from the study at any time, without affecting their future diabetes management.

3.2.5 Analytical methods

HbA1c was measured by high-pressure liquid chromatography using HA 8160 analyser (the assay was aligned to the Diabetes Control and Complications trial

(DCCT)). Total cholesterol and triglycerides were measured using enzymatic methods (Olympus AU 2700 or AU 640 machines). HDL was measured using Ultra N-geneous HDL cholesterol assay, (Genzyme diagnostics, UK) and LDL was calculated using the Friedewald equation. Urinary albumin was measured using the Cobas Mira S utilizing Audit Diagnostics Microalbumin kit. Liver and renal function was measured by standard laboratory methods.

3.2.6 Statistical analysis

Frequencies and descriptive statistics were used for information such as age, gender and duration of disease. Continuous data are expressed as either mean +/- standard deviation (SD) or standard error of mean (SEM), and were compared for significance using a two-sample t test. Categorical data were compared using Chi-square (χ^2), a non-parametric test, to test for significant difference between the two related samples, standard and intensive groups. Cross tabulations were used to analyse relationships between variables and enabled data to be displayed, summarised and visually compared. The level of statistical significance was identified by the P value $p< 0.05$. All of the analysis was performed using the Statistical Package for Social Sciences (SPSS 11.0 - 13; Chicago, IL, USA).

3.3 Part 2 – Vascular Risk Factor Questionnaire

This part of the study aimed at capturing any perceived difference between the standard and intensive groups with regard to patient knowledge of and attitudes towards, diabetes and heart disease, following their participation in the study.

3.3.1 Study design

It is difficult when assessing knowledge of diabetes to decide which instrument should be used. According to Glasgow (1997), there are a large number of psychosocial measures available, which assess related but different factors. When general versus diabetes-specific measures have previously been compared, diabetes-specific assessments usually appear to be stronger measures when exploring issues relating to diabetes, such as Quality of Life (Glasgow and Toobert 1988, Bradley 1994 and Welch et al 1994). However, according to Glasgow (1997), the one drawback to assessing only diabetes-specific issues is that one may not acquire a holistic view of the patient. Glasgow (1997) suggests that in order to develop

individualized plans with patients, it is necessary to understand both the patients' perspective and the social environment in which they are managing their diabetes. This is particularly relevant with regard to the elderly who have co-morbidities. Consequently it is important to know the full history of medications and interactions before planning diabetes related interventions (Glasgow 1997).

From a review of the literature, it would appear that questionnaires are one of the most commonly used data collection instruments used in nursing research (Coates 2004). They are designed to gather data from individuals, regarding knowledge, attitudes, beliefs and feelings and are useful for asking subjects to report data about themselves (Coates 2004). They need careful wording to ensure that the form of the questions is clear to the respondent, free of suggestion and grammatically correct. Questionnaires are much less costly in time and money to administer to a large number of subjects. It is important that they have the potential to be completely anonymous ensuring there is no possibility of interviewer bias (Coates 2004).

There is no standardized instrument available to assess attitudes, knowledge or awareness of hypertension (Oliveria et al 2005) or for measuring knowledge of risk factors for coronary heart disease (Alm-Roijer et al 2004). On reviewing the literature, the questionnaires used in many studies related to diabetes, examine a range of issues such as quality of life (Diabetes Quality of Life measure (DQOL) (Jacobson et al 1994), satisfaction with treatment, (The Diabetes Treatment Satisfaction Questionnaire (DTSQ) (Bradley 1994) or satisfaction with aspects of service provided by a diabetes clinic, i.e. waiting times, privacy (Diabetes Clinic Satisfaction Questionnaire (DCSQ) Bradley 1994), Diabetes Knowledge Questionnaire (DKQ) (Villagomez 1989). These questionnaires did not ask the specific questions relating to patient's knowledge of vascular risks, knowledge of heart disease and its relationship to diabetes, knowledge of blood pressure and cholesterol and therefore was not suitable for the purpose of this study. A questionnaire developed by Wagner et al (2005b) to measure heart disease knowledge in people with diabetes, the Heart Disease Fact Questionnaire, did look at very general areas of heart disease and its relationship to diabetes, but did not measure the specific questions which were required for this study such as did patients' know what their vascular risk targets should be, what their adherence to medication was, how

often they would like to be seen, to name some questions. For the purposes of this study a questionnaire was devised to ascertain patient knowledge of vascular risk factors. In addition, it looked at a number of areas related to diabetes in general (Appendix 7).

3.3.2 Questionnaire

The questionnaire consisted of predominately closed ended questions. However, there were 3 questions of a qualitative nature, whereby patients could give their comments. The questionnaire had four sections looking at demographics, knowledge of vascular risks, heart disease and attitudes to diabetes management. The first section, containing 7 questions, looked at the characteristics of the group in question, gender, age range, treatment and management of diabetes. The second section, containing 5 questions, was designed to look at patients' knowledge of what their blood pressure and cholesterol reading should be. These questions had a fixed number of alternative responses, one of which was the correct answer. Further questions ascertained whether the respondents were, to the best of their knowledge, on medication for blood pressure and cholesterol and if so, compliance with said medication.

The third section contained 3 questions with a number of parts assigned to each question. Questions were neutrally worded, utilizing a number of Likert-type attitudinal scale. This section was designed to measure patients' knowledge of heart disease and vascular risk factors and their relationship to diabetes. Patients were asked how important these areas were in relation to the treatment of diabetes. Two scoring keys were used, a) true, false, don't know and b) a little, a lot, don't know. In addition, patients were asked whether they felt they had received enough information regarding vascular risks and diabetes. The scoring keys used included: agree / strongly agree / undecided / disagree and strongly disagree. The final section containing 12 questions was designed to measure attitudes to their diabetes management using a Likert scale from strongly agree to strongly disagree, how often they would like to be seen by the diabetes nurse specialist / hospital doctor, and whether they thought the study was beneficial to them. A space for comments was also provided.

3.3.3 Pilot

The questionnaire was piloted on two occasions prior to being sent to respondents in the study. A total of 40 people took part in the pilot aspect of the study – some patients involved in the randomized controlled aspect of the study, plus patients attending the diabetes centre for a routine check up. Following the pilot, minimal changes were made. These involved minor refinement of the wording or response formats of three questions for further clarification. The questionnaires were reviewed by medical and nursing colleagues involved in diabetes care and their comments incorporated into the final questionnaire. Patients who participated in both the pilot study and the randomized controlled aspect of the study (three patients in intensive group and two in standard group) were not included in the final analysis.

3.3.4 Sample

Data from patients who completed part 1 of the study were reviewed to assess whether any patients had died or were unable to complete the questionnaire for any other reason. After exclusion of those patients who had died (n=4) and those who took part in the pilot study (n=5), a total of 179 questionnaires were sent out – 88 to patients in the Intensive group and 91 to patients in the Standard group. As mentioned previously, patients in the standard group received routine follow up in the out-patient clinic. They received general diabetes advice, i.e. treatment of hypoglycaemia, sharps disposal and adjusting of insulin if relevant, but did not receive any advice on vascular risks or any changes in their management. Patients in the intensive group were seen by the vascular intervention nurse every 2-3 months and were given individual verbal and written advice on lifestyle modifications, such as diet, weight reduction, exercise, alcohol consumption and smoking. Patients were given the results of their blood tests so they could track their progress and were advised how the results related to current recommendations.

3.3.5 Procedure

Ethical approval was sought and obtained from Beaumont Hospital Ethics Committee. A covering letter explaining the purpose and the intended use of the information being sought in the questionnaire was sent to each participant (Appendix 6). Information related to the purpose and the intended use of the information being sought in the questionnaire, was also written on the top of each questionnaire. It was

assumed that consent by the patient was given, if they returned the questionnaire. No form of identification was incorporated on the questionnaires, therefore, respondents' anonymity and confidentially was guaranteed. The questionnaires were colour coded to ensure ease of analysing the data. Intensive patients were given yellow questionnaires and standard patients were given white questionnaires. A stamped addressed envelope was included with the questionnaire.

The questionnaire was sent between 1-2 years following completion of part 1 of the study, the time scale of when it was sent was different for each patient, depending on the date they entered the randomized controlled part of the study.

3.3.6 Statistical analysis

Analyses used were frequencies and descriptive statistics, so a broad picture of background information such as age, gender, duration of disease could be obtained (Coates 2004). Cross tabulations were used to analyse relationships between variables and enable data to be displayed, summarised and visually compared. Chi-square (χ^2), a non-parametric test, was used to test for significant difference between the two related samples, standard and intensive groups. The level of statistical significance was identified by the P value $p< 0.05$.

Questions 5, 6, 8 and 10 (Appendix 7), which had a number of fixed responses relating to different target levels of which only one was correct), were recoded to 2 responses, 'Correct' or 'Incorrect / don't know. Questions 15 – 21, which had 'strongly agree' and 'agree' were recoded to 'agree', in addition, 'strongly disagree' and 'disagree' were recoded to 'disagree'. All of the analysis was performed using the Statistical Package for Social Sciences (SPSS 13.0; Chicago, IL, USA)

Chapter 4
Research Findings

4.1 Introduction

This chapter presents the results of the research conducted. The first part of the study aimed to determine whether an intensive, nurse-led, protocol driven clinic could achieve recommended vascular risk reduction targets in patients with type 2 diabetes. Patients were followed for a period of one year. Data was collected and education given by one Diabetes Nurse Specialist. The second part of the study aimed to ascertain whether diabetes patients attending the intensive vascular intervention clinic would have a clearer understanding of the relationship between diabetes and heart disease than those randomised to standard diabetic care. Data was collected by way of a questionnaire.

4.2 Results of Part 1 of study - randomized controlled trial

This section looks at the nurse-led randomized controlled aspect of the study and presents the results under a number of different heading such as:

- Hypertension
- Dyslipidaemia
- Glycaemic control
- Lifestyle interventions.

4.2.1 Demographics

At the start of the study, there were 101 patients in the intensive group and 99 patients in the standard group. Following randomisation, 5 patients dropped out from the standard group (2 died: 3 defaulted) and 7 patients dropped out from the intensive group (1 died: 6 defaulted) and were not included in the following analyses. Therefore, follow-up data was available on 94 patients in each group. Both groups were matched at baseline for demographic and clinical characteristics (Table 4.2.1) except more patients in the standard group than the intensive group were on diuretic therapy (p 0.022).

Table 4.2.1 Basic demographic and clinical characteristics of patients at start of study (mean ± SD / %)

	Standard n = 94	**Intensive n = 94**	**P value**
M/F	50:44	52:42	n/s
Age (yrs)	61.7±8.8	61.6±8.8	n/s
Duration DM (yrs)	7.15 ± 5.5	7.26 ± 5.7	n/s
Weight (kgs)	88.4±15.5	88.7±14.46	n/s
HBAIC (%)	7.1±1.4	7.1±1.4	n/s
Total Cholesterol (mmol/L)	4.6±0.9	4.7±0.8	n/s
Triglycerides (mmol/L)	3.03±3.3	3.07±3.6	n/s
HDL-c (mmol/L)	1.04±.3	1.00±0.3	n/s
LDL –c (mmol/L)	2.4±0.7	2.5±.73	n/s
SBP (mmHg)	149.4± 21.9	146.9 ± 20.9	n/s
DBP (mmHg)	81.4 ± 11.6	80.3 ± 10.7	
Diabetes treatment:			
Diet only	20 (21.3%)	18 (19.1%)	n/s
Oral hypoglycaemic agents	52 (55.3%)	56 (59.6%)	
Insulin	17 (18.1%)	18 (19.1%)	
Oral hypoglycaemic agents + Insulin	5 (5.3%)	2 (2.1%)	
Anti-platelet therapy			
Aspirin	66 (70.2%)	70 (74.5%)	n/s
Clopidogrel	3 (3.2%)	2 (2.1%)	n/s
Warfarin	9 (9.8%)	2 (2.1%)	n/s
Hypertension (n / %)	92 (97.9%)	94 (100%)	n/s
Blood Pressure agents			
ACE inhibitor	55 (59.8%)	55 (58.5%)	n/s
Beta Blocker	17 (18.5%)	18 (19.1%)	n/s
Calcium Channel blockers	29 (31.5%)	22 (23.4%)	n/s
Angiotensin 2 antagonist	9 (9.8%)	10 (10.6%)	n/s
Alpha blocker	10 (10.9%)	11 (11.7%)	n/s
Diuretic	33 (35.9%)	19 (20.2%)	.022
Dyslipidaemia (n / %)	77 (81.9%)	79 (84.0%)	n/s
Statin therapy	61 (79.2%)	59 (74.7%)	n/s
Smoker	12 (12.8%)	13 (13.8%)	n/s

SBP = Systolic blood pressure; DBP = Diastolic blood pressure; TC = Total cholesterol; HDL -c = high-density lipoprotein; LDL-c = low-density lipoprotein; HbA1c = haemoglobin A1c; ACE = angiotensin converting enzyme

4.2.2 Age profile of participants

The average age of patients in both the standard and intensive groups, was 61 years (Table 4.2.1), 55.9% patients were over 60 years of age (Table 4.2.2).

Table 4.2.2 Age Group

	Standard	Intensive	Total	P value
<40 yrs	0 (0.0%)	2 (2.1%)	2 (1.1%)	n/s
40 – 60 yrs	45 (47.9%)	36 (38.3%)	81 (43.1%)	
>60 yrs	49 (52.1%)	56 (59.6%)	105 (55.9%)	

The average duration of time with diabetes was 7 years (Table 4.2.1), 43.1% of patients diagnosed with diabetes less than 5 years (Table 4.2.3).

Table 4.2.3 Duration of diabetes

	Standard	Intensive	Total	P value
< 5 yrs	44 (46.8%)	37 (39.4%)	81 (43.1%)	n/s
5 – 10 yrs	31 (33.0%)	34 (36.2%)	65 (34.6%)	
>10 yrs	19 (20.2%)	23 (24.5%)	42 (22.3%)	

4.2.3 Macrovascular disease

As can be seen (Table 4.2.1)**,** 100% of patients (n=94) in the intensive group had hypertension at the start of the study and 97.9% (n=92) in the standard group. Furthermore, Table 4.2.1 shows that 84% of patients (n=79) in the intensive group had dyslipidaemia at the start of the study and 81.9% in the standard group (n=77). In addition, quite a number of patients had a history of macrovascular disease (Table 4.2.4). Seventeen percent of patients had a history of a myocardial infarction (MI), 17.6% had a history of angiography ± insertion of a stent, 10.6% had a history of a coronary artery bypass graft (CABG) and 5.3% of patients had a history of a cerebrovascular accident (CVA).

Table 4.2.4 Macrovascular disease

	Standard	Intensive	Total	P value
MI	20 (21.3%)	12 (12.8%)	32 (17.0%)	n/s
CVA	6 (6.4%)	4 (4.3%)	10 (5.3%)	n/s
Angiography ± stent	16 (17.0%)	17 (18.1%)	33 (17.6%)	n/s
CABG	12 (12.8%)	8 (8.5%)	20 (10.6%)	n/s

Patients had an ECG at the beginning and the end of the study to ascertain whether they had evidence of heart disease, (silent MI, heart block, left ventricular hypertrophy or ischaemia). A total of 48.6% of patients had an abnormal ECG at the end of the study, 37.0% in the intensive group and 60.2% in the standard group (p 0.002). During the study, one patient in both groups was admitted to hospital and underwent a CABG resulting from an abnormal ECG.

Table 4.2.5 Abnormal ECG

	Standard		Intensive		P value
Abnormal ECG	Start of study	End of study	Start of study	End of study	P value
	50 (53.2%)	56 (60.2%)	41 (43.6%)	34 (37.0%)	0.002

4.3 Blood pressure

Only patients who at the start of the study fitted the criteria for hypertension, (those who were on anti-hypertension medication or, those patients who had blood pressure >130/80 mmHg), were included in the following blood pressure analysis, 100% of patients in the intensive group and 97.9% of patients in the standard group. The intensive group had a greater reduction in systolic BP than the standard group

(-10.5 ± 1.8 v 1.7 ± 2.0) (p <0.001). Furthermore, the intensive group had a reduction in diastolic BP (-5.9 ± 0.9) whereas, there was only a slight decrease in diastolic BP in the conventional group (-0.5 ± 1.0) (p <0.001), (Table 4.3.1).

Table 4.3.1 Change in blood pressure during the study

	Standard (n=92)		Change in standard variables at end of study	Intensive (n=94)		Change in intensive variables at end of study	Difference in change between groups at end of study
Variable	Start of study	End of study	Mean ± SEM	Start of study	End of study	Mean ± SEM	P value
SBP	150.0 ± 21.7	151.8 ± 20.5	1.7 ± 2.0	146.9 ± 20.9	136.4 ± 14.9	- 10.5 ± 1.8	0.001
DBP	81.8 ± 11.4	81.3 ± 10.4	- 0.51 ± 1.0	80.3 ± 10.7	74.4 ± 9.9	- 5.9 ± 0.9	0.001

4.3.1 Blood pressure targets

After one year 33.0% of those patients with hypertension in the intensive group, reached a target systolic BP < 130 mmHg compared with 12.0% in the standard group (p 0.001). In addition, only 16% of patients in the intensive group were > 150 mmHg versus 55.4% in the standard group (p 0.001)(Table 4.3.2).

Looking at diastolic blood pressure, 75.5% of patients in the intensive group and 40.2% patients in the standard group reached a target diastolic BP < 80 mmHg (p 0.001) (Table 4.3.2). In addition, only 6.4% of patients in the intensive group were > 90 mmHg versus 16.3% in the standard group (p 0.038).

Table 4.3.2 Breakdown of blood pressure targets pre and post study (n /%)

	Standard (n=92)		Intensive (n=94)		Difference between groups at end of study
Variable	Start of study	End of study	Start of study	End of study	P value
SBP< 130 mmHg	15 (16.3%)	11 (12.0%)	17(18.1%)	31 (33.0%)	0.001
< 135 mmHg	23 (25.0%)	23 (25.0%)	26 (27.7%)	44 (46.8%)	0.002
< 140 mmHg	36 (39.1%)	30 (32.6%)	41 (43.6%)	67 (71.3%)	0.001
130-150 mmHg	36 (39.1%)	30 (32.6%)	41 (43.6%)	48 (51.1%)	0.012
> 150 mmHg	41(44.6%)	51 (55.4%)	36 (38.3%)	15 (16.0%)	0.001
DBP < 80 mmHg	40 (43.5%)	37 (40.2%)	44 (46.8%)	71 (75.5%)	0.001
< 85 mmHg	59 (64.1%)	59 (64.1%)	60 (63.8%)	81 (86.2%)	0.001
80-90 mmHg	34 (37.0%)	40 (43.5%)	35 (37.2%)	17 (18.1%)	0.001
< 90 mmHg	72 (78.3%)	78 (84.8%)	76 (80.9%)	88 (93.6%)	n/s
> 90 mmHg	18 (19.6%)	15 (16.3%)	15 (16.0%)	6 (6.4%)	0.038

*shaded results - less conservative target ranges, not included in total figures
Footnotes: SBP = Systolic blood pressure; DBP = Diastolic blood pressure

4.3.2 Change in blood pressure targets over the duration of the study

In total, there were 13.4% of patients who were >130 mmHg at the start of the study and had reduced their systolic blood pressure to <130 mmHg by the end of the study, 21.3% of patients in the intensive group and 5.4% of the standard group (Table 4.3.3). There was no change in blood pressure in 78.5% of patients, with 11.7% in the intensive group and 6.5% in the standard group remaining <130 mmHg throughout the study.

Table 4.3.3 Change in systolic blood pressure over the duration of the study

		Group (N / %)					
SBP		Standard n=92		Intensive n=94		Total change	P value
<130 mmHg	Increase in BP	9 (9.8%)		6 (6.4%)		15 (8.1 %)	0.006
	No change	78 (84.8%)	6 (6.5%) remained <130 mmHg	68 (72.3%)	11 (11.7%) remained <130 mmHg	146 (78.5%)	
			72 (78.3%) remained >130 mmHg		57 (60.6%) remained >130 mmHg		
	Reduction in BP	5 (5.4%)		20 (21.3%)		25 (13.4%)	

Taking into account the change in diastolic blood pressure over time (Table 4.3.4), one can see that there were 21.5% of patients who were >80 mmHg at the start of the study and had reduced their diastolic blood pressure to <80 mmHg by the end of the study, 34% of patients in the intensive group and 8.7% of the standard group. There was no change in blood pressure in 69.9% patients, with 41.5% of patients in the intensive group and 31.5% in the standard group, remaining < 80 mmHg throughout the study.

Table 4.3.4 Change in diastolic blood pressure over the duration of the study

		Group (N / %)					
DBP		Standard n=92		Intensive n=94		Total change	P value
<80 mmHg	Increase in BP	11 (12.0%)		5 (5.3%)		16 (8.6 %)	0.001
	No change in BP	73 (79.4%)	29 (31.5%) remained < 80 mmHg	57 (60.6%)	39 (41.5%) remained < 80 mmHg	130 (69.9%)	
			44 (47.9%) remained > 80 mmHg		18 (19.1%) remained > 80 mmHg		
	Reduction in BP	8 (8.7%)		32 (34.0%)		40 (21.5%)	

4.3.3 Anti-hypertensive agents

Both groups were matched with regards to drug therapy at the beginning of the study (Table 4.2.1), except there were more patients on diuretics in the standard group (35.9%) at the beginning of the study, as opposed to the intensive group (20.2%) (p 0.022). In contrast, more patients were on A 2 antagonists (45.7% v 20.7%, p<0.001) and Alpha blockers (29.8% v 12.0%, p 0.004) in the intensive group at the end of the study (Table 4.3.5). Also, more patients in the intensive group were on maximum dose of these anti-hypertensive agents, than patients in the standard group.

Table 4.3.5 Anti-hypertensive agents at the end of the study

Variable	Standard (n=92)	Intensive (n=94)	Difference between groups at end of study
BP agents	End of study	End of study	P value
A2 antagonist	19 (20.7%)	43 (45.7%)	0.001
Max dose	4 (4.3%)	20 (21.3%)	0.002
Ace inhibitor	55 (59.8%)	62 (66.0%)	n/s
Max dose	22 (23.9%)	42 (44.7%)	0.036
B Blocker	19 (20.7%)	13 (13.8%)	n/s
Max dose	7 (7.6%)	6 (6.5%)	n/s
Ca Channel	30 (32.6%)	27 (28.7%)	n/s
Max dose	14 (15.2%)	15 (16.0%)	n/s
Diuretic	37 (40.2%)	51 (54.3%)	n/s
A blocker	11 (12.0%)	28 (29.8%)	0.004
Max dose	2 (2.2%)	17 (18.1%)	0.007

4.3.4 Change in anti-hypertensive agents over the duration of the study

In Table 4.3.6, where the change between groups was calculated over time, it can be seen that there was an increase of 37.2% in the prescribing of A2 antagonists in the intensive group as opposed to 12% in standard group (p<0.001). In addition, there was an increase in prescribing of diuretics, 34% in the intensive group as opposed to 7.6% in standard group (p<0.001), Alpha blockers, 19.1% in the intensive group as opposed to 2.2% in standard group (p 0.001), ACE inhibitors, 20.2% in the intensive group as opposed to 8.7% in standard group (p 0.039) and Calcium Channel agents, 12.8% in the intensive group as opposed to 4.3% in standard group (p 0.045). There was no significant difference in prescribing of Beta Blockers.

Table 4.3.6 Change in anti-hypertensive agents during the study

		Standard (n=92)		Intensive (n=94)		Total change	P value
A2 antagonist	Reduction in meds	1 (1.1%)		2 (2.1%)		3 (1.6%)	<0.001
	No change in meds	80 (86.9%)	8 (8.6%) remained on A2	57 (60.6%)	8 (8.5%) remained on A2	137 (73.7%)	
			72 (78.3%) not on A2		49 (52.1%) not on A2		
	Increase in meds	11 (12%)		35 (37.2%)		46 (24.7%)	
ACE Inhibitor	Reduction in meds	8 (8.7%)		12 (12.8%)		20 (10.8%)	0.039
	No change in meds	76 (82.6%)	47 (51.1%) remained on ACE	63 (67%)	43 (45.7%) remained on ACE	139 (74.4%)	
			29 (31.5%) not on ACE		20 (21.3%) not on ACE		
	Increase in meds	8 (8.7%)		19 (20.2%)		27 (14.5%)	
B Blocker	Reduction in meds	2 (2.2%)		6 (6.4%)		8 (4.3%)	n/s
	No change in meds	86 (93.4%)	15 (16.3%) remained on B Blocker	87 (92.5%)	12 (12.7%) remained on B Blocker	173 (93%)	
			71 (77.1%) not on B Blocker		75 (79.8%) not on B Blocker		
	Increase in meds	4 (4.3%)		1 (1.1%)		5 (2.7%)	
Ca Channel agent	Reduction in meds	3 (3.3%)		7 (7.4%)		10 (5.4%)	0.045
	No change in meds	85 (92.3%)	26 (28.2%) remained on Ca C	75 (79.7%)	15 (15.9%) remained on Ca C	160 (86%)	
			59 (64.1%) not on Ca C		60 (63.8%) not on Ca C		
	Increase in meds	4 (4.3%)		12 (12.8%)		16 (8.6%)	
Diuretic	Reduction in meds	3 (3.3%)		0 (.0%)		3 (1.6%)	<0.001
	No change in meds	82 (89.1%)	30 (32.6%) remained on diuretic	62 (65.9%)	19 (20.2%) remained on diuretic	144 (77.4%)	
			52 (56.5%) not on diuretic		43 (45.7%) not on diuretic		
	Increase in meds	7 (7.6%)		32 (34%)		39 (21%)	
A Blocker	Reduction in meds	1 (1.1%)		1 (1.1%)		2 (1.1%)	0.001
	No change in meds	89 (96.7%)	9 (9.8%) remained on A Blocker	75 (79.7%)	10 (10.6%) remained on A Blocker	164 (88.2%)	
			80 (86.9%) not on A Blocker		65 (69.1%) not on A Blocker		
	Increase in meds	2 (2.2%)		18 (19.1%)		20 (10.8%)	

4.3.5 Number of anti-hypertensive agents

At the beginning of the study, more patients in the standard group (20.7%) were on 3 or more anti-hypertensive agents than in the intensive group (12.8%). In contrast, at the end of the study, there were substantially more patients in the intensive group (45.7%) on 3 or more anti-hypertensive agents compared with 25.0% in the standard group (p 0.004).

Table 4.3.7 Number of anti-hypertensive agents

Variable	Standard (n=92)	Intensive (n=94)	Difference between groups at end of study
	End of study	End of study	P value
No BP agents	13 (14.1%)	6 (6.4%)	0.004
1 agent	17 (18.5%)	22 (23.4%)	
2 agents	39 (42.4%)	23 (24.5%)	
3 or more agents	23 (25.0%)	43 (45.7%)	

Looking at change over time between the groups (Table 4.3.8), it can be seen that there were more changes in the number of agents in the intensive group than in the standard group.

4.3.8 Change in the number of anti-hypertensive agents

Agents			Standard (n=92)		Intensive (n=94)		P value
Reduction in meds	1 agent	1 → 0	2 (2.2%)	1 (1.1%)	0 (.0%)	0 (0.0%)	0.001
		2 → 1		1 (1.1%)		0 (0.0%)	
	2 agents	2 → 0	2 (2.2%)		0 (.0%)		
	3 agents	3 → 0	1 (1.1%)		0 (.0%)		
No change in meds			68 (73.9%)	18 (19.6%) remained on 3 agents	41 (43.6%)	12 (12.8%) remained on 3 agents	
				26 (28.2%) remained on 2 agents		11 (11.7%) remained on 2 agents	
				13 (14.1%) remained on 1 agent		12 (12.8%) remained on 1 agent	
				11 (12.0%) remained on no medication		6 (6.3%) remained on no medication	
Increase in meds	1 agent	2 → 3	18 (19.6%)	4 (4.3%)	42 (44.7%)	20 (21.3%)	
		1 → 2		11 (12.0%)		12 (12.8%)	
		0 → 1		3 (3.3%)		10 (10.6%)	
	2 agents	1 → 3	1 (1.1%)		10 (10.6%)		
	3 agents	0 → 3	0 (.0%)		1 (1.1%)		

4.3.6 Blood pressure interventions

The number of patients in the intensive group (45.7%) who had four or more blood pressure interventions (increasing doses of current medication, or addition of further agents) was substantially higher than in the standard group (4.3%)(p 0.001) (Table

4.3.9). In fact in the intensive group, 6.4% of patients had 7 interventions, 3.2% had 8 interventions and 2.1% of patients had 11 interventions.

Table 4.3.9 Blood pressure interventions during the study

	Group (n / %)		
Blood pressure interventions during the study	Standard (n=92)	Intensive (n=94)	P value
No interventions	43 (46.7%)	11 (11.7%)	0.001
1 intervention	27 (29.3%)	9 (9.6%)	
2 interventions	8 (8.7%)	14 (14.9%)	
3 or more interventions	10 (10.9%)	17 (18.1%)	
4 or more interventions	4 (4.3%)	43 (45.7%)	

4.4 Lipids

Only those patients who, at the start of the study, fitted the criteria for dyslipidaemia, (those patients who were on statin therapy, or who had raised total cholesterol or LDL cholesterol), were included in the following analysis, 81.9% of patients in the intensive group, and 84.0% in the standard group. The biochemical results for LDL-c, HDL-c and triglycerides are not constant throughout the study. This was due to the fact that some patients may not have these variables measured, or when a patient's total cholesterol or triglyceride level were markedly elevated, it was not possible to measure the HDL-c or LDL-c levels. Therefore only those results which were available were included in the following analysis.

Patients in the intensive group had greater reduction in total cholesterol (-0.69 ± 0.1) compared to the standard group (-0.16 ± 0.1), (p 0.001) (Table 4.4.1). There was also a significant difference in LDL-c, but no significant differences for HDL and triglycerides.

Table 4.4.1 Change in lipids during the study

	Standard (n=77)		Change in standard variables at end of study	Intensive (n=79)		Change in intensive variables at end of study	Difference in change between groups at end of study
Variable	Start of study	End of study	Mean ± SEM	Start of study	End of study	Mean ± SEM	P value
TC	4.69± 0.9	4.53± 0.9	- 0.16 ± 0.1	4.78 ± 0.9	4.09 ± 0.8	- 0.69 ± 0.1	0.001
LDL	2.4 ± 0.7	2.4± 0.7	- 0.01 ± 0.1	2.54 ± 0.8	2.0 ± 0.6	- 0.54 ± 0.1	0.001
HDL	1.02 ± 0.3	1.05± 0.3	0.02 ± 0.0	1.0 ± 0.3	1.0 ± 0.3	0.02 ± 0.0	n/s
Trigs	3.20 ± 3.6	2.60± 1.7	- 0.60 ± 0.4	3.3 ± 3.8	2.45 ± 1.7	- 0.83 ± 0.3	n/s

4.4.1 Lipid targets

At the start of the study a total of 53.8% of patients reached the target total cholesterol of < 4.8 mmol/L. Whereas, at the end of the study, a total of 74.4% of patients reached the target of < 4.8 mmol/L, 84.8% of patients in the intensive group and 63.6% in the standard group (p 0.003). As can be seen there was a significant difference in LDL cholesterol during the study, with 84.1% in the intensive group reaching the target of < 2.6 mmol/L compared with 62.1% in the standard group (p 0.003). There was no significant difference between groups with regard to HDL cholesterol or triglycerides (Table 4.4.2).

Table 4.4.2 Breakdown of lipid targets pre and post study (n /%)

	Standard (n=77)		Intensive (n=79)		P value between groups at end of study
Variable	Start of study	End of study	Start of study	End of study	P value
TC < 4.8 mmol/L	43 (55.8%)	49 (63.6%)	41 (51.9%)	67 (84.8%)	0.003
4.8 – 6 mmol/L	27 (35.1%)	24 (31.2%)	32 (40.5%)	11 (13.9%)	0.012
<5 mmol/L	45 (58.4%)	57 (74.0%)	48 (60.8%)	70 (88.6%)	0.024
> 6 mmol/L	7 (9.1%)	4 (5.2%)	6 (7.6%)	1 (1.3%)	n/s
Triglycerides < 1.9 mmol/L	28/77 (36.4%)	32/76 (42.1%)	25/79 (31.6%)	38/79 (48.1%)	n/s
HDL-c > 1 mmol/L	34/74 (45.9%)	41/75 (54.7%)	37/76 (48.7%)	35/75 (46.7%)	n/s
LDL-c < 2.6 mmol/L	39/64 (60.9%)	41/66 (62.1%)	32/66 (48.5%)	58/ 69 (84.1%)	0.006

Footnotes: TC = Total cholesterol; HDL -c = high-density lipoprotein; LDL-c = low-density lipoprotein

4.4.2 Change in total cholesterol over the duration of the study

Again, if looking at the change in total cholesterol during the study (Table 4.4.3), 41.8% patients in the intensive group and 19.5% in the standard group whom at the start of the study, were > 4.8 mmol/L reduced their cholesterol to < 4.8 mmol/L by the end of the study (p 0.011). However, there was no change in cholesterol in 59.0% of patients, with 43.0% in intensive group and 44.1% of patients in the standard group remaining < 4.8 mmol/L throughout the study.

Table 4.4.3 Change in total cholesterol over the duration of the study (n /%)

		Group (N / %)					
TC		Standard (n=77)		Intensive (n=79)		Total change	P value
Total cholesterol <4.8 mmol/L	Increase in cholesterol	9 (11.7%)		7 (8.9%)		16 (10.3%)	0.011
	No change in cholesterol	53 (68.8%)	34 (44.1%) remained < 4.8 mmol/L	39 (49.3%)	34 (43.0%) remained < 4.8 mmol/L	92 (59.0%)	
			19 (24.7%) remained > 4.8 mmol/L		5 (6.3%) remained > 4.8 mmol/L		
	Reduction in cholesterol	15 (19.5%)		33 (41.8%)		48 (30.8%)	

4.4.3 Statin therapy

At the end of the study, 96.2% of patients with dyslipidaemia in the intensive group were receiving statin therapy compared to 87.0% in the standard group (p 0.045) and 27.8% and 20.8% respectively were on maximum therapy (p = n/s) (Table 4.4.4). Only 1 patient in either group was on fibrate therapy at the completion of the study and this was in addition to statin therapy.

Table 4.4.4 Statin therapy during the study

	Standard (n=77)		Intensive (n=79)		Difference between groups at end of study
Variable	Start of study	End of study	Start of study	End of study	P value
Statin	61 (79.2%)	67 (87.0%)	59 (74.7%)	76 (96.2%)	0.045
Max dose	12 (15.6%)	16 (20.8%)	11 (13.9%)	22 (27.8%)	n/s

If change in statin therapy between groups is looked at, although there was an increase in the number of patients in the intensive group on statin therapy (22.8%) compared to the standard group (9.1%) (Table 4.4.5) there was no overall significant difference.

Table 4.4.5 Change in statin therapy during the study

		Standard (n =77)		Intensive (n =79)		Total change	P value
Statin	Stopped statin therapy	1 (1.3%)		1 (1.3%)		2 (1.3%)	n/s
	No change in meds	69 (89.6%)	60 (77.9%) remained on statin	60 (75.9%)	58 (73.4%) remained on a statin	129 (82.7%)	
			9 (11.7%) not on a statin		2 (2.5%) not on a statin		
	Started statin therapy	7 (9.1%)		18 (22.8%)		25(16.0%)	

4.4.4 Lipid interventions

The number of patients in the intensive group who had 2 or more lipid interventions during the study (44.3%), was significantly higher than the standard group (7.8% patients), (p <0.001) (Table 4.4.6). These interventions included increasing the dose of current therapy or changing to a different agent.

Table 4.4.6 Lipid interventions during the study

Group (n / %)				
Lipid interventions during the study	Standard (n=77)	Intensive (n=79)	Total (n=156)	P value
No interventions	54 (70.1%)	23 (29.1%)	77 (49.4%)	0.001
1 intervention	17 (22.1%)	21 (26.6%)	38 (24.4%)	
2 or more interventions	6 (7.8%)	35 (44.3%)	41 (26.3%)	

4.5 Glycaemic Control

When looking at change in HbA1c over time between the groups, the intensive group had a reduction in HbA1c (-0.34 ± 0.13), whereas there was a minimal reduction in the standard group (p 0.013) (Table 4.5.1).

Table 4.5.1 Change in Glycaemic control during the study

	Standard (n=94)		Change in standard variables at end of study	Intensive (n=94)		Change in intensive variables at end of study	Difference in change between groups at end of study
Variable	Start of study	End of study	Mean ± SEM	Start of study	End of study	Mean ± SEM	P value
HbA1c	7.1±1.4	7.2±1.5	0.12 ± 0.1	7.1±1.4	6.8 ± 1.4	- 0.34 ± 0.1	0.013

4.5.1 Glycaemic targets

In the intensive group, 52.1% reached target HbAlc (< 6.5%) compared with 33.0% in the standard group (p 0.012) (Table 4.5.2). Furthermore, using a less conservative target range (< 7%), a total of 58.5% of patients, 66.0% of patients in the intensive group and 51.1% in the standard group reached this target (p 0.054).

Table 4.5.2 Breakdown of glycaemic targets pre and post study (n /%)

	Standard (n=94)		Intensive (n=94)		Difference between groups at end of study
Variable	Start of study	End of study	Start of study	End of study	P value
HbA1c <6.5 (%)	32 (34.0%)	31 (33.0%)	39 (41.5%)	49 (52.1%)	0.012
<7 (%)	49 (52.1%)	48 (51.1%)	44 (46.8%)	62 (66.0%)	0.54
6.5 – 8 (%)	42 (44.7%)	40 (42.6%)	31(33.0%)	32 (34.0%)	n/s
>8 (%)	20 (21.3%)	23 (24.5%)	24 (25.5%)	13 (13.8%)	n/s

Footnotes: HbA1c = Haemoglobin A1c

4.5.2 Change in glycaemic targets during the study

If looking at the change in glycaemic targets during the study (Table 4.5.3), 14.4% of patients whom at the start of the study were > 6.5%, had reduced their HbA1c to < 6.5% by the end of the study, 19.1% of patients in the intensive group and 9.6% in the standard group (p n/s). However, there was no change in HbA1c in 76.1% of patients, with 32.9% in intensive group and 23.4% of patients remaining < 6.5% throughout the study.

Table 4.5.3 Change in glycaemic targets during the study

		Group (N / %)					
HbA1c		Standard		Intensive		Total	P value
HbA1c <6.5%	Increase in HbA1c	10 (10.6%)		8 (8.5%)		18 (9.6%)	n/s
	No change in HbA1c	75 (79.8%)	22 (23.4%) remained < 6.5%	68 (72.3%)	31 (32.9%) remained < 6.5%	143 (76.1%)	
			53 (56.4%) remained > 6.5%		37 (39.4%) remained > 6.5%		
	Reduction in HbA1c	9 (9.6%)		18 (19.1%)		27 (14.4%)	

4.5.3 Diabetes treatment regimes

There was a slight increase in the number of patients on oral hypoglycaemic agents in addition to insulin in the intensive group otherwise there was no difference in drug treatment in either group at the end of the study (Table 4.5.4).

Table 4.5.4 Diabetes treatment regimes

Variable	Standard (n=94)		Intensive (n=94)		Difference between groups at end of the study
Diabetes management	Start of study	End of study	Start of study	End of study	P value
Diet controlled	20 (21.3%)	16 (17.0%)	18 (19.1%)	16 (17.0%)	n/s
OHA	52 (55.3%)	58 (61.7%)	56 (59.6%)	53 (56.4%)	
Insulin	17 (18.1%)	15 (16.0%)	18 (19.1%)	15 (16.0%)	
OHA and insulin	5 (5.3%)	5 (5.3%)	2 (2.1%)	10 (10.6%)	

4.5.4 Change in diabetes treatment regimes during the study

When looking at change over time (Table 4.5.5), there was no change in treatment in a large percent of patients. Of note 2 patients in the intensive group stopped oral hypoglycaemic agents during the study and reverted to diet control. Also 3 patients in the standard group and 1 patient in the intensive group, who were on insulin at the start of study, reverted back to oral hypoglycaemic agents. As can be been seen, there

were more changes in diabetes treatment, particularly in the intensive group, with slightly more patients in the intensive group on insulin therapy.

Table 4.5.5 Change in diabetes treatment regimes during the study

Diabetes Treatment			Standard (n=92)		Intensive (n=94)		P value
Reduction in meds	1 change	Insulin → OHA	3 (3.2%)	3 (3.2%)	3 (3.2%)	1 (1.1%)	n/s
		OHA → Diet		0 (.0%)		2 (2.1%)	
	2 changes	OHA & insulin → OHA	1 (1.1%)		0 (.0%)		
No change in meds			83 (88.3%)	17 (18.1%) remained diet controlled	77 (81.9%)	14 (14.9%) remained diet controlled	
				48 (51.1%) remained on OHA		49 (52.1%) remained on OHA	
				14 (14.9%) remained on insulin		12 (12.8%) remained on insulin	
				4 (4.2%) remained on OHA & insulin		2 (2.1%) remained on OHA & insulin	
Increase in meds	1 change	Diet → OHA	7 (7.4%)	4 (4.2%)	10 (10.6%)	3 (3.2%)	
		OHA → insulin		2 (2.1%)		2 (2.1%)	
		Insulin → OHA & insulin		1 (1.1%)		5 (5.3%)	
	2 changes	Diet → insulin	0 (.0%)	0 (.0%)	4 (4.3%)	1 (1.1%)	
		OHA → OHA & insulin		0 (.0%)		3 (3.2%)	

4.5.5 Glycaemic interventions during the study

In the intensive group 36.2% of patients had three or more glycaemic interventions compared with 5.3% in the standard group, ($p < 0.001$) (Table 4.5.6). These interventions included increasing the dose of current therapy, or, if glycaemic target was not reached and patients were on one agent, adding another agent or changing to a different agent.

Table 4.5.6 Glycaemic interventions during the study

	Group (n / %)			
Glycaemic interventions during the study	Standard (n=94)	Intensive (n=94)	Total (n=188)	P value
No interventions	46 (48.9%)	32 (34%)	78 (41.5%)	0.001
1 intervention	30 (31.9%)	14 (14.9%)	44 (23.4%)	
2 interventions	13 (13.8%)	14 (14.9%)	27 (14.4%)	
3 or more interventions	5 (5.3%)	34 (36.2%)	39 (20.7%)	

4.6 Weight

As can be seen in Table 4.6.1, there was no a significant difference in weight between groups during the study. Body Mass Index (BMI) was not measured.

Table 4.6.1 Change in weight during the study

	Standard (n=94)		Change in variables at end of study	Intensive (n=94)		Change in variables at end of study	Difference between groups at end of study
Variable	Start of study	End of study	Mean ± SEM	Start of study	End of study	Mean ± SEM	P value
Wt	88.4 ± 15.5	88.6 ± 16.4	0.15 ± 0.4	88.7 ± 14.6	89.0 ± 15.3	0.26 ± 0.4	n/s

4.7 Smoking

At the end of the study, 9.0% of patients were still smoking, 9.6% in standard group and 8.5% in intensive group, five patients in intensive group stopped smoking and three patients in the standard group. A number of patients were ex-smokers (46.3%).

4.8 Anti-platelet therapy

87.2% of patients in the intensive group compared to 74.5% in the standard group were on aspirin by the end of the study (p 0.040) (Table 4.8.1). In addition, there were a number of patients in either group on both Aspirin and Clopidogrel. One patient in the intensive group was unable to take Aspirin due to a gastric ulcer.

Table 4.8.1 Anti-platelet therapy during the study

Variable	Standard (n=94)		Intensive (n=94)		Difference between groups at end of study
Anti-platelet therapy	Start of study	End of study	Start of study	End of study	P value
Aspirin	66 (70.2%)	70 (74.5%)	70 (74.5%)	82 (87.2%)	0.040
Clopidogrel	3 (3.2%)	4 (4.3%)	2 (2.1%)	7 (7.4%)	n/s
Warfarin	9 (9.6%)	9 (9.6%)	2 (2.1%)	3 (3.2%)	n/s

4.9 Adverse events

Forty adverse events occurred in the intensive group compared to ten in the standard group. In the intensive group, seven patients required reduction in the dose or stopped diuretic therapy due to slight worsening of renal function, seven patients stopped calcium channel blocker due to ankle oedema, fourteen patients stopped

ACE- inhibitors due to a cough, four patients stopped angiotensin-2 antagonists due to stomach cramps. Four patients required reduction of the sulphonylurea dose due to hypoglycaemia and three patients stopped Metformin due to gastrointestinal upset. One patient on a statin had raised creatinine kinase associated with myositis and temporarily stopped statin therapy, but after a period of time recommenced a different agent.

In the standard group, seven patients stopped ACE Inhibitors due to a cough, two patients stopped calcium channel blocker due to ankle oedema and one patient stopped diuretics due to worsening renal function.

4.10 Lifestyle interventions

As mentioned previously, patients in the standard group did not receive any education about vascular risk factors during the study. However they could have had education from other sources such as the diabetes day centre, OPD or from their GP. Patients in the intensive group were given advice regarding modifiable risk factors such as diet, smoking and exercise. As can be seen (Table 4.10.1), 45.7% of patients in the intensive group had two or more exercise interventions; this would be in the form of discussing exercise in general and possibly setting a target for that respondent to work on prior to the next visit. In the intensive group, 51.1% of patients had two or more diet interventions, including looking at portions sizes, snacks and type of food eaten. A diet sheet was given if appropriate, with a basic food plan. Patients were asked if they wished to see the dietician, but no respondent wished to see the dietician.

Patients in both groups were given general diabetes education regarding;-

a) Treatment of hypoglycaemia
b) Blood glucose targets
c) Timing of blood testing and hand washing
d) Sharps disposal
e) Home blood glucose monitoring.

As can be seen (Table 4.10.1), both groups were given diabetes education, but as the intensive group were seen every 2 – 3 months and education was reinforced at each visit, 62.8% of patients in the intensive group had 3 or more interventions. In

addition, as can be seen (Table 4.10.1), both groups required counselling on a number of psychological issues not related to diabetes specifically, but which could cause stress and therefore could affect blood pressure and glycaemic control. These issues varied between general support and encouragement, counselling, referral to a social worker / counsellor, bereavement and possibly referral to bereavement counsellor in hospital, family stress, illness or death – spouse, parent, child or grandchild.

Table 4.10.1 Lifestyle interventions during the study

		Group (n / %)		
		Standard (n=94)	Intensive (n=94)	P value
Exercise interventions during the study	No interventions	93 (98.9%)	31 (33.0%)	0.001
	1 intervention	1 (1.1%)	20 (21.3%)	
	2 or more interventions	0 (0.0%)	43 (45.7%)	
Diet interventions during the study	No interventions	89 (94.7%)	19 (20.2%)	0.001
	1 intervention	5 (5.3%)	27 (28.7%)	
	2 or more interventions	0 (0.0%)	48 (51.1%)	
Diabetes education interventions during the study	No interventions	21 (22.3%)	12 (12.8%)	0.001
	1 intervention	14 (14.9%)	11 (11.7%)	
	2 interventions	42 (44.7%)	12 (12.8%)	
	3 or more interventions	17 (18.1%)	59 (62.8%)	
Psychosocial interventions during the study	No interventions	40 (42.6%)	14 (14.9%)	0.001
	1 intervention	20 (21.3%)	13 (13.8%)	
	2 interventions	19 (20.2%)	18 (19.1%)	
	3 or more interventions	15 (16.0%)	49 (52.1%)	

4.11 Results of Part 2 of the study – Risk Factor Questionnaire

The study aimed to ascertain whether diabetes patients attending the vascular intervention clinic would have a clearer understanding of the relationship between diabetes and heart disease than those randomised to standard diabetic care. This section looks at the results obtained from the vascular risk questionnaire sent to patients. The following analysis looked at the various risk factors and combined questions related to specific subjects such as:

- Hypertension
- Dyslipidaemia
- Glycaemic control
- Quantitative and qualitative analysis relating to the study

As all participants of the study did not always answer each question in the questionnaire, the total number of respondents for each variable is not constant and only those who answered the questions were included in the relevant analyses.

4.11.1 Demographics

There was a 75% response rate to the questionnaire. A total of 134 patients returned questionnaires, 69/91 (76%) patients in the standard group and 65/88 (74%) patients in the intensive group. There was also verbal contact by post / telephone, that one patient had died in the intensive group and 1 patient was in hospital.

4.11.2 Gender and age profile

The gender breakdown in the total group was 57% males and 42% females (Table 4.11.1), with a larger although insignificant percentage of males in the intensive group 41/65 (63.1%) than the standard group 36/69 (52.2%).

Table 4.11.1 Gender

	Group (N / %)			
Gender	Standard (n=69)	Intensive (n=65)	Total (n=134)	P value
Male	36 (52.2%)	41 (63.1%)	77 (57.5%)	n/s
Female	33 (47.8%)	24 (36.9%)	57 (42.5%)	

The age profile of the group showed that the largest percentage of patients (37.3%) were in 60 – 69 age group (Table 4.11.2), indeed the majority of patients were ≥ 60 years (66.4%).

Table 4.11.2 Age Profile

		Group (n / %)			
		Standard (n=69)	Intensive (n=65)	Total (n=134)	P value
Age group	30 - 39	0 (0.0%)	1 (1.5%)	1 (0.7%)	n/s
	40 - 49	3 (4.3%)	5 (7.7%)	8 (6.0%)	
	50 - 59	22 (31.9%)	14 (21.5%)	36 (26.9%)	
	60 - 69	24 (34.8%)	26 (40.0%)	50 (37.3%)	
	Over 70	20 (29.0%)	19 (29.2%)	39 (29.1%)	

4.12 Diabetes treatment regimes

Table 4.12.1 provides detailed information in response to the question relating to diabetes treatment. A total of 57.6% of patients were on oral hypoglycaemic agents, 57.4% in the standard group and 57.8% in the intensive group.

Table 4.12.1 Diabetes treatment regimes

	Group (N / %)			
Diabetes treatment	Standard (n=68)	Intensive (n=64)	Total (n=132)	P value
Diet controlled only	8 (11.8%)	4 (6.3%)	12 (9.1%)	n/s
Diet and tablets	39 (57.4%)	37 (57.8%)	76 (57.6%)	
Diet, tablets and insulin	7 (10.3%)	13 (20.3%)	20 (15.2%)	
Diet and insulin only	14 (20.6%)	10 (15.6%)	24 (18.2%)	

Question 7 asked if patients were on insulin or medication, which could potentially cause hypoglycaemia (low blood sugar). However, surprisingly only 29.3% of patients were aware of the correct treatment of hypoglycaemia (Table 4.12.2).

Table 4.12.2 Treatment of hypoglycaemia

	Group (N / %)			
Treatment of hypoglycaemia	Standard (n=41)	Intensive (n=34)	Total (n=75)	P value
Lucozade plus bread / biscuits	12 (29.3%)	10 (29.4%)	22 (29.3%)	n/s
Incorrect / don't know	29 (70.7%)	24 (70.6%)	53 (70.7%)	

4.13 Questions related to Blood Pressure

Table 4.13.1 provides detailed information and responses to a number of questions relating to blood pressure. It can be seen that only 32.8% of patients knew what their ideal blood pressure should be (< 130/80 mmHg). However, 91% of patients indicated that they knew blood pressure control was very important in the treatment of diabetes. A high percentage of patients in the total group appeared to be aware that weight gain (98.4%) and stress (96.1%) can also affect your blood pressure. As can be seen there are no significant differences between the standard and intensive group for any of these variables.

Table 4.13.1 Questions relating to Blood pressure

(Number: S / I)		Group (n / %)			
		Standard	Intensive	Total	P value
Ideal blood pressure (125: 67 / 58)	Correct	19 (28.4%)	22 (37.9%)	41 (32.8%)	n/s
	Incorrect / don't know	48 (71.6%)	36 (62.1%)	84 (67.2%)	
How important is blood pressure control in the treatment of diabetes (122: 62 / 60)	A little	1 (1.6%)	3 (5.0%)	4 (3.3%)	n/s
	A lot	55 (88.7%)	56 (93.3%)	111 (91.0%)	
	Don't know	6 (9.7%)	1 (1.7%)	7 (5.7%)	
Weight gain affects your blood pressure (125: 67/ 58)	True	65 (90.7%)	58 (100%)	123 (98.4%)	n/s
	False / don't know	2 (3.0%)	0 (0.0%)	2 (1.6%)	
Stress affects your blood pressure (127: 67 / 60)	True	62 (92.5%)	60 (100%)	122 (96.1%)	n/s
	False / don't know	5 (7.5%)	0 (0.0%)	5 (3.9%)	
I have received enough information regarding Blood pressure and diabetes (120: 62 / 58)	Agree	48 (77.4%)	50 (86.2%)	98 (81.7%)	n/s
	Disagree	4 (6.5%)	0 (0.0%)	4 (3.3%)	
	Undecided	10 (16.1%)	8 (13.8%)	18 (15.0%)	

4.14 Questions related to Cholesterol

Table 4.14.1 provides detailed information and responses to a number of questions relating to cholesterol. Only 34.9% of patients knew what their ideal cholesterol should be (< 4.8 mmol/L), with a higher percent in the intensive group (41.4%) than the standard group (29.4%). However, 87.7% of patients indicated that they knew how important reducing cholesterol was in the treatment of diabetes and 92.8% of patients appeared to be aware that high cholesterol can affect your blood vessels. There are no significant differences between the standard and intensive group for any of these variables.

Table 4.14.1 Questions relating to cholesterol

(Number: S / I)		Group (n / %)			
		Standard	Intensive	Total	P value
Ideal cholesterol (126: 68 / 58)	Correct	20 (29.4%)	24 (41.4%)	44 (34.9%)	n/s
	Incorrect/don't know	48 (70.6%)	34 (58.6%)	82 (65.1%)	
How important is reducing cholesterol in the treatment of diabetes (122: 64 / 58)	A little	2 (3.1%)	2 (3.4%)	4 (3.3%)	n/s
	A lot	54 (84.4%)	53 (91.4%)	107 (87.7%)	
	Don't know	8 (12.5%)	3 (5.2%)	11 (9%)	
High cholesterol can affect your blood vessels (125: 66 / 59)	True	61 (92.4%)	55 (93.2%)	116 (92.8%)	n/s
	False / don't know	5 (7.6%)	4 (6.8%)	9 (7.2%)	
I have received enough information regarding cholesterol and diabetes (117: 61 / 56)	Agree	45 (73.8%)	48 (85.7%)	93 (79.5%)	n/s
	Disagree	6 (9.8%)	1 (1.8%)	7 (6.0%)	
	Undecided	10 (16.4%)	7 (12.5%)	17 (14.5%)	

4.15 Questions related to Glycaemic control

Table 4.15.1 provides detailed information and responses to a number of questions relating to glycaemic control. It can be seen that only 31.9% of patients knew what their ideal HbA1c (<6.5%) should be. Whereas, a higher percentage of patients, (77.1%), knew what their ideal blood sugar should be (between 4-8 mmol/L). A total of 93.7% of patients indicated that they knew how important blood sugar control is in the treatment of diabetes. More patients in the intensive group (81.7%) felt that it would be easier to control their diabetes by having a check up every 2/3 months than in the standard group (70.8%). A total of 81.7% of patients felt that they had received enough information regarding blood sugar control and diabetes**.** As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.15.1 Questions relating to glycaemic control

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	P value
Ideal HbA1c (116: 64 / 52)	Correct	16 (25.0%)	21 (40.4%)	37 (31.9%)	n/s
	Incorrect / Don't know	48 (75.0%)	31 (59.6%)	79 (68.1%)	
Ideal blood sugar (131: 69 / 62)	Correct	50 (72.5%)	51 (82.3%)	101 (77.1%)	n/s
	Don't know	19 (27.5%)	11 (17.7%)	30 (22.9%)	
How important is blood sugar control in the treatment of diabetes (127: 66 / 61)	A little	2 (3.0%)	3 (4.9%)	5 (3.9%)	n/s
	A lot	61 (92.4%)	58 (95.1%)	119 (93.7%)	
	Don't know	3 (4.5%)	0 (0.0%)	3 (2.4%)	
It would be easier to control my diabetes by having a check up every 2-3 months (125: 65 / 60)	Agree	46 (70.8%)	49 (81.7%)	95 (76.0%)	n/s
	Disagree	6 (9.2%)	4 (6.7%)	10 (8.0%)	
	Undecided	13 (20.0%)	7 (11.7%)	20 (16.0%)	
I have received enough information regarding blood sugar control and diabetes (121: 64 / 57)	Agree	60 (93.8%)	55 (96.5%)	115 (95.0%)	n/s
	Disagree	2 (3.1%)	2 (3.5%)	4 (3.3%)	
	Undecided	2 (3.1%)	0 (0.0%)	2 (1.7%)	

4.16 Questions related to diet, weight and exercise

Table 4.16.1 provides detailed information and responses to a number of questions relating to diet / weight and exercise. It can be seen that a high percentage of patients (91.2%) know how important diet is in the treatment of diabetes. A total of 96.8% of patients felt that they had received enough information regarding diet, weight reduction and diabetes. A total of 74.4% of patients indicated that they felt it would be easier to control their diabetes by having a check up every 2 - 3 months. More patients in the intensive group (93.3%) knew how important exercise was in the treatment of diabetes, than the standard group (82.8%). A total of 97.6% of patients

felt that they had received enough information regarding the benefits of exercise and diabetes. As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.16.1 Questions relating to diet, weight and exercise

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	P value
How important is diet in the treatment of diabetes (125: 64 / 61)	A little	3 (4.7%)	6 (9.8%)	9 (7.2%)	n/s
	A lot	59 (92.2%)	55 (90.2%)	114 (91.2%)	
	Don't know	2 (3.1%)	0 (0.0%)	2 (1.6%)	
I have received enough information regarding diet, weight reduction and diabetes (124: 65 / 59)	Agree	63 (96.9%)	57 (96.6%)	120 (96.8%)	n/s
	Disagree	2 (3.1%)	1 (1.7%)	3 (2.4%)	
	Undecided	0 (0.0%)	1 (1.7%)	1 (0.8%)	
It would be easier to control my weight by having a check up every 2-3 months (125: 65 / 60)	Agree	46 (70.8%)	47 (78.3%)	93 (74.4%)	n/s
	Disagree	6 (9.2%)	2 (3.3%)	8 (6.4%)	
	Undecided	13 (20.0%)	11 (18.3%)	24 (19.2%)	
How important is exercise in the treatment of diabetes (124: 64 / 60)	A little	9 (14.1%)	4 (6.7%)	13 (10.5%)	n/s
	A lot	53 (82.8%)	56 (93.3%)	109 (87.9%)	
	Don't know	2 (3.1%)	0 (0.0%)	2 (1.6%)	
I have received enough information regarding benefits of exercise and diabetes (124: 65 /59)	Agree	63 (96.9%)	58 (98.3%)	121 (97.6%)	n/s
	Disagree	1 (1.5%)	1 (1.7%)	2 (1.6%)	
	Undecided	1 (1.5%)	0 (0.0%)	1 (0.8%)	

4.17 Questions related to smoking and alcohol

Only a small percentage (6.1%) of those who returned questionnaires, were smokers, 4/68 (5.9%) in standard group and 4/63 (6.3%) in intensive group. Table 4.17.1, provides detailed information and responses to a number of questions relating to smoking and alcohol. A high percentage of patients in both groups, appeared to be aware that smoking affects your blood vessels, 62/65 (95.4%) in the standard group and 57/58 (98.3%) in the intensive group. A total of 107/116 (92.2%) patients were aware of the importance of quitting smoking in the treatment of diabetes, 52/57 (91.2%) in standard group and 55/59 (93.2%) in intensive group. A total of 104/112 (92.9%) patients felt that they had received enough information regarding risks of smoking and diabetes, 54/56 (96.4%) in the standard group and 50/56 (89.3%) in the intensive group. A total of 68.9% patients were aware that only moderate alcohol intake is important in the treatment of diabetes. Furthermore, a total of (86.3%) patients felt that they had received enough information regarding alcohol and diabetes. As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.17.1 Questions relating to smoking and alcohol

(Number: S / I)		Group (N / %)			P value
		Standard	Intensive	Total	
Smoking affects your blood vessels (123: 65 / 58)	True	62 (95.4%)	57 (98.3%)	119 (96.7%)	n/s
	False / Don't know	3 (4.6%)	1 (1.7%)	4 (3.3%)	
How important is quitting smoking in the treatment of diabetes (116: 57 / 59)	A little	4 (7.0%)	1 (1.7%)	5 (4.3%)	n/s
	A lot	52 (91.2%)	55 (93.2%)	107 (92.2%)	
	Don't know	1 (1.8%)	3 (5.1%)	4 (3.4%)	
I have received enough information regarding risks of smoking and diabetes (112: 56 / 56)	Agree	54 (96.4%)	50 (89.3%)	104 (92.9%)	n/s
	Disagree	1 (1.8%)	3 (5.4%)	4 (3.6%)	
	Undecided	1(1.8%)	3 (5.4%)	4 (3.6%)	
How important is only moderate alcohol intake in the treatment of diabetes (119: 61 / 58)	A little	13 (21.3%)	16 (27.6%)	29 (24.4%)	n/s
	A lot	43 (70.5%)	39 (67.2%)	82 (68.9%)	
	Don't know	5 (8.2%)	3 (5.2%)	8 (6.7%)	
I have received enough information regarding alcohol and diabetes (117: 62 / 55)	Agree	52 (83.9%)	49 (89.1%)	101 (86.3%)	n/s
	Disagree	4 (6.5%)	1 (1.8%)	5 (4.3%)	
	Undecided	6 (9.7%)	5 (9.1%)	11 (9.4%)	

4.18 Questions related to heart disease and circulation

Table 4.18.1 provides patients' responses to questions relating to heart disease and circulation. It can be seen that a high percentage of patients, 116/130 (89.2%), know that heart disease is a problem associated with diabetes, 61/68 (89.7%) in the standard group and 55/62 (88.7%) in the intensive group. A total of 106/128 (82.82%) patients knew that stroke disease is a problem associated with diabetes, 56/68 (82.4%) in the standard group and 50/60 (83.3%) in the intensive group, whereas only 85/123 (69.1%) of patients knew that hardening of the arteries is a problem associated with diabetes, 45/67 (67.2%) in the standard group and 40/56 (71.4%) in the intensive group. As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.18.1 Questions relating to heart disease and circulation

(Number: S / I)		Group (N / %)			P value
The following are a problem associated with diabetes		Standard	Intensive	Total	
Heart disease (130: 68 / 62)	True	61 (89.7%)	55 (88.7%)	116 (89.2%)	n/s
	False / Don't know	7 (10.3%)	7 (11.3%)	14 (10.8%)	
Stroke disease (128: 68 / 60)	True	56 (82.4%)	50 (83.3%)	106 (82.8%)	n/s
	False / Don't know	12 (17.6%)	10 (16.7%)	22 (17.2%)	
Hardening of the arteries (123: 67 / 56)	True	45 (67.2%)	40 (71.4%)	85 (69.1%)	n/s
	False / Don't know	22 (32.8%)	16 (28.6%)	38 (30.9%)	

4.19 Questions related to blood pressure medication

Table 4.19.1 provides detailed information and responses to questions relating to blood pressure medication. A sizable majority of patients 113/130 (86.9%), answered that they were on blood pressure medication to the best of their knowledge, 59/69 (85.5%) in the standard group and 54/61 (88.5%) in the intensive group. There were a number of patients who answered "Yes" regarding being on blood pressure medication, but did not answer the question "do they ever forget to take their medication". Of those who answered, a high percentage of patients 82/102 (80.4%) said they never forget to take their medication, 44/55 (80%) in standard group and 38/47 (80.9%) in the intensive group. As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.19.1 Questions relating to blood pressure medication

(Number: S / I)		Group (N / %)			P value
		Standard	Intensive	Total	
Are you on blood pressure medication to the best of your knowledge (130: 69 / 61)	Yes	59 (85.5%)	54 (88.5%)	113 (86.9%)	n/s
	No	10 (14.5%)	7 (11.5%)	17 (13.1%)	
Do you ever forget to take your blood pressure medication (102: 55 / 47)	Never	44 (80.0%)	38 (80.9%)	82 (80.4%)	n/s
	Once / twice week	1 (1.8%)	2 (4.3%)	3 (2.9%)	
	Once a month	10 (18.2%)	7 (14.9%)	17 (16.7%)	

4.20 Questions related to cholesterol medication

Table 4.20.1 provides detailed information and responses to questions relating to cholesterol medication. A total of 94/121 (77.7%) patients answered that they were on cholesterol medication to the best of their knowledge, 54/63 (85.7%) in the standard group and 40/58 (69.0%) in the intensive group. A total of 67/85 (78.8%) patients said they never forget to take their medication, 40/49 (81.6%) in standard group and 27/36 (75.0%) in the intensive group.

Table 4.20.1 Questions related to cholesterol medication

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	P value
Are you on cholesterol medication to the best of your knowledge (121: 63 / 58)	Yes	54 (85.7%)	40 (69.0%)	94 (77.7%)	0.031
	No	9 (14.3%)	18 (31.0%)	27 (22.3%)	
Do you ever forget to take your cholesterol medication (85: 49 / 36)	Never	40 (81.6%)	27 (75.0%)	67 (78.8%)	n/s
	Once/twice week	2 (4.1%)	4 (11.1%)	6 (7.1%)	
	More than once/twice week	1 (2.0%)	1 (2.8%)	2 (2.4%)	
	Once a month	6 (12.2%)	4 (11.1%)	10 (11.8%)	

4.21 Questions related to how often patients would like to be seen regarding their diabetes

Table 4.21.1 provides patients' responses to questions relating to how often patients would like to be seen regarding their diabetes. It can be seen that 39.8% wished to be seen by the diabetes nurse every three months - 28/65 (43.1%) in the standard group and 23/63 (36.5%) in the intensive group. Only 25.4% of patients wished to be seen by the doctor every 3 months - 18/67 (26.9%) in the standard group and 14/59 (23.7%) in the intensive group. Interestingly, 54% of patients wished to be seen every six months by the doctor in the OPD, 36/67 (53.7%) in the standard group and 32/59 (54.2%) in the intensive group. There are no significant differences between the standard and intensive group for any of these variables.

Table 4.21.1 Questions relating to frequency of visits

(Number: S / I)		Group (N / %)			
	Months	Standard	Intensive	Total	P value
How often would you like to be seen by the diabetes nurse (128: 65 / 63)	2	3 (4.6%)	8 (12.7%)	11 (8.6%)	n/s
	3	28 (43.1%)	23 (36.5%)	51 (39.8%)	
	6	25 (38.5%)	26 (41.3%)	51 (39.8%)	
	12	9 (13.8%)	6 (9.5%)	15 (11.7%)	
How often would you like to be seen by the doctor in OPD (126: 67 / 59)	2	1 (1.5%)	4 (6.8%)	5 (4.0%)	n/s
	3	18 (26.9%)	14 (23.7%)	32 (25.4%)	
	6	36 (53.7%)	32 (54.2%)	68 (54.0%)	
	12	12 (17.9%)	9 (15.3%)	21 (16.7%)	

4.22 Quantitative and qualitative analysis regarding choice of personnel for diabetes care

Respondents were asked in Question 25, if they had a choice, whom would they prefer to see regarding their diabetes care. A high percentage of patients, 88/124 (71.0%), wished to be seen by both the hospital doctor and the diabetes nurse (Table 4.22.1), 44/65 (67.7%) of patients in the standard group and 44/59 (74.6%) of patients in the intensive group. As can be seen, there are no significant differences between the standard and intensive group for any of these variables.

Table 4.22.1 Choice of personnel and diabetes care

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	
If you had choice whom would you like to see regarding your diabetes (124: 65 / 59)	Hospital doctor only	0 (0.0%)	1 (1.7%)	1 (0.8%)	n/s
	Diabetes nurse only	21 (32.3%)	13 (22.0%)	34 (27.4%)	
	Both hospital doctor and diabetes nurse	44 (67.7%)	44 (74.6%)	88 (71.0%)	
	GP	0 (0.0%)	1 (1.7%)	1 (0.8%)	

The (b) part of this question asked 'why' and responses were grouped in themes. A total of 83/130 (63.8%) patients replied to the (b) question, 41/67 (61.2%) of patients in the standard group and 42/63 (66.7%) in the intensive group. Some of the main themes that emerged from those respondents wishing to see both the doctor and the nurse included;

* Doctors prescribe treatment whereas the nurse ensures that the patient knows how to implement their treatment.
* Nurses have more time than the doctor to spend with the patient due to time constraints in the outpatient clinic.
* Hospital doctor and nurse are more up to date with the management of diabetes than the GP.

A total of 27% of patients wished to be seen by the diabetes nurse only (Table 4.22.1), 32.3% of patients in the standard group and 22% of patients in the intensive group. Some of the main themes that emerged from those respondents wishing to see the diabetes nurse only, were;

* Feel more comfortable dealing with the nurse who knows them better
* Nurses have more time and are more understanding than the doctor

4.23 Quantitative and qualitative analysis relating to the benefit of the study

Respondents were asked in Question 27, if they felt it was beneficial to be in the study. As can be seen (Table 4.23.1), a high percentage of patients, 115/126 (91.3%), felt it was beneficial being in the study, 53/64 (82.8%) of patients in the standard group and all the patients in the intensive group ($p < 0.001$).

Table 4.23.1 Benefit of the study

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	P value
It was beneficial to me being in the study (126: 64 / 62)	Agree	53 (82.8%)	62 (100%)	115 (91.3%)	0.001
	Disagree	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	Undecided	11 (17.2%)	0 (0.0%)	11 (8.7%)	

The (b) part of this question asked 'why'. A total of 107/128 (83.6%) of patients replied to the (b) question, 53/66 (80.3%) of patients in the standard group and 54/62 (87.1%) of patients in the intensive group. Some of the main themes that emerged were;

* The feedback enabled the patients to understand diabetes and the risks associated with it and enabled them to be more confident in managing their diabetes.
* Nurse has more time to give to the patient and explains things well.

A high percentage of patients (90.6%) felt it was beneficial to see the same nurse every visit, 57/68 (83.8%) of patients in the standard group and 59/60 (98.3%) of patients in the intensive group (p 0.005) (Table 4.23.2). In addition, 93.8% of patients said they would like to know the results of their blood pressure / blood tests at each visit, 62/68 (91.2%) in the standard group and 59/61 (96.7%) in the intensive group. A total of 89.1%of patients felt that they had more knowledge about diabetes after the study, 56/68 (82.4%) of patients in the standard group and 58/60 (96.7%) of patients in the intensive group (p 0.032). When patients were asked had they received enough information regarding the complications of diabetes, only 68.5% agreed, 39/58 (67.2%) in the standard group and 37/53 (69.8%) of patients in the intensive group.

Table 4.23.2 Knowledge and information relating to the study

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	P value
It was beneficial to see the same nurse every visit during the study (128: 68 / 60)	Agree	57 (83.8%)	59 (98.3%)	116 (90.6%)	0.005
	Disagree	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	Undecided	11 (16.2%)	1 (1.7%)	12 (9.4%)	
It would be helpful to know results of blood pressure / blood tests at every visit (129: 68 / 61)	Agree	62 (91.2%)	59 (96.7%)	121 (93.8%)	n/s
	Disagree	3 (4.4%)	0 (0.0%)	3 (2.3%)	
	Undecided	3 (4.4%)	2 (3.3%)	5 (3.9%)	
I have more knowledge about diabetes after the study (128: 68 / 60)	Agree	56 (82.4%)	58 (96.7%)	114 (89.1%)	0.032
	Disagree	2 (2.9%)	0 (0.0%)	2 (1.6%)	
	Undecided	10 (14.7%)	2 (3.3%)	12 (9.4%)	
I have received enough information regarding the complications of diabetes (111: 58 / 53)	Agree	39 (67.2%)	37 (69.8%)	76 (68.5%)	n/s
	Disagree	7 (12.1%)	7 (13.2%)	14 (12.6%)	
	Undecided	12 (20.7%)	9 (17.0%)	21 (18.9%)	

A total of 87/116 (75.0%) patients said that they get most of their information regarding diabetes from the diabetes nurse, 39/60 (65.0%) in the standard group and 48/56 (85.7%) in the intensive group (p 0.025) (Table 4.23.3).

Table 4.23.3 Information relating to diabetes

(Number: S / I)		Group (N / %)			
		Standard	Intensive	Total	
Where do you get most information regarding your diabetes (116: 60 / 56)	Hospital doctor	14 (23.3%)	7 (12.5%)	21 (18.1%)	0.025
	Diabetes nurse	39 (65.0%)	48 (85.7%)	87 (75.0%)	
	DFI	5 (8.3%)	0 (0.0%)	5 (4.3%)	
	GP	0 (0.0%)	1 (1.8%)	1 (0.9%)	
	Other	2 (3.3%)	0 (0.0%)	2 (1.7%)	

4.24 Quantitative and qualitative analysis of comments made relating to other issues of the study, or diabetes management in general

Respondents were asked at the end of the questionnaire if they had any other comments to make on issues not covered in the questionnaire. Only a small percentage (26%) of patients replied, with more patients in the intensive group making comments, 22/64 (34.4%) compared with 12/67 (17.9%) of patients in the standard group (p 0.046). Some of the main issues mentioned were;

* Would be helpful to get a written copy of the results of blood pressure and cholesterol and have more discussion on ideal and acceptable blood pressure and cholesterol targets.
* Wanting to know more about tablets, which medication is for which condition and the side effects associated with the medication.
* Not enough time is spent dealing with foot care in relation to diabetes.
* Would prefer to be seen more frequently in the OPD, possibly every three to six months.
* Learnt a lot about diabetes and its management
* Frequency of visits and fact that there was no pressure on time when seeing nurse in the study, helped to maintain weight and bloods
* Being in the study helped understanding about blood pressure and cholesterol and the targets which one was aiming for to prevent complications.

CHAPTER FIVE

DISCUSSION AND RECOMMENDATIONS

5.1 Introduction

The findings of this study, which is the first of its kind in Ireland, provide an insight into two aspects of diabetes care, namely the benefits of a nurse-led vascular risk reduction clinic and secondly patient's lack of knowledge regarding vascular risk targets. In this chapter, the main findings of the research are discussed, conclusions in relation to the study objectives are presented and recommendations are made for future research into this area. The discussion is divided into two main sections, the Randomized Controlled Trial and the Risk Factor Questionnaire.

5.2 Randomized Controlled Trial

In this section, the main findings in relation to the randomized controlled trial are discussed. Some aspects of this section will overlap with the second section and are discussed as appropriate in each of the individual sections.

5.2.1 Background

It is well known that good glycaemic control reduces the incidence and progression of microvascular disease in type 1 and type 2 diabetes (DCCT 1993, Ohkubo et al 1995, UKPDS (33) 1998, UKPDS (34) 1998) and more recently the impact of hyperglycaemia on cardiovascular disease has become more evident (Stratton et al 2000, Smith et al 2002, Selvin et al 2004). Despite this evidence based knowledge, control of cardiovascular risk factors in the USA and Europe is inadequate, with half to two-thirds of patients with type 2 diabetes not achieving target levels of glycaemia (Johansen et al 2007). Grant et al (2004) suggested clinical inertia as the reason for the low rate of starting or intensifying therapy in patients with type 2 diabetes who have not reached targets recommended for glycaemic control, hypertension or dyslipidaemia.

This study looked at nurse-led management of vascular risk factors and demonstrated that an intensive, nurse-led, multi-intervention clinic was more successful in achieving vascular risk reduction targets than standard diabetes care. More patients achieved target systolic BP in the intensive (33.0%) than in the standard group (12.1%, $p < 0.001$) (Table 4.3.2). The corresponding figures for diastolic BP were 75.5% and 40.2% respectively ($p < 0.001$). Target cholesterol was reached in 84.8% patients in the intensive group and 63.6% in the standard group (p 0.003) (Table 4.4.2); the corresponding figures for target LDL cholesterol were 73.4% and 54.5% respectively (p 0.007). Target HbA1c was reached in 53.2% patients in the intensive group and 32.9% in the standard group (p 0.005) (Table 4.5.2).

The ADA (2006) recommends aggressive treatment of cardiovascular risk factors, with more stringent target levels for lipids and blood pressure than those recommended for the general population. Intensive glucose lowering is essential for the prevention of microvascular disease, but aggressive lipid and blood pressure lowering is central to the prevention of macrovascular complications in patients with type 2 diabetes (Huang et al 2001). A high percentage of patients in this study had hypertension at screening. In addition, 50.5% of the patient group had a history of macrovascular disease. As discussed previously, patients had an ECG performed at the beginning and the end of the study and it can be seen (Table 4.11.2) that at the end of the study, there were significantly less patients in the intensive group (37.0%) with an abnormal ECG compared with the standard group (60.2%) (p 0.002).

Despite the fact that guidelines for the aggressive treatment of hypertension, hyperglycaemia and dyslipidaemia (NCEP 2001, Chobanian et al 2003, and ADA 2007) are widely published, physicians are still neither aggressively diagnosing, nor treating dyslipidaemia or hypertension in patients with diabetes (Meigs 2000). It is important therefore to try and address the barriers which prevent aggressive management of diabetes care. Larme and Pugh (2001) suggest that it is important to disseminate practice guidelines and provide continuing medical education on diabetes to physicians, lack of resources and time constraints need to be addressed, along with increasing public awareness of diabetes.

5.2.2 Hypertension

The results of this study show that at baseline (Table 4.3.2), of those patients with hypertension, 18.1% in the intensive group and 16.3% in standard group, had a systolic BP target < 130 mmHg. In contrast, at the end of the study, 33% in the intensive group reached the target systolic blood pressure of < 130 mmHg (Table 4.3.2). Taking into account the change in systolic blood pressure during the study, it can be seen that a total of 13.4% of patients were > 130 mmHg at the start of the study but reduced their systolic blood pressure to < 130 mmHg by the end of the study, 21.3% of patients in the intensive group and 5.4% of the standard group (Table 4.3.3). Despite this improvement in SBP in the intensive group, 67% of patients remained above the recommended blood pressure target. In contrast, if looking at less conservative target cut off points used in many studies, it can be seen that, 71.3% patients in the intensive group and 32.6% of patients in the standard group achieved a systolic BP < 140 mmHg, ($p < 0.001$) (Table 4.3.2).

When looking at diastolic blood pressure, of those patients with hypertension, 46.8% in the intensive group and 43.5% in standard group, had a diastolic BP target < 80 mmHg. In contrast, at the end of the study, 75.5% of patients in the intensive group and 40.2% patients in the standard group reached a target diastolic BP < 80 mmHg (p 0.001) (Table 4.3.2). Taking into account the change in diastolic blood pressure over time (Table 4.3.4), 21.5% of patients who were > 80 mmHg at the start of the study reduced their diastolic blood pressure to < 80 mmHg by the end of the study, 34% of patients in the intensive group and 8.7% of the standard group. Again, if one looks at a more conservative target range, 86.2% of patients in the intensive group and 64.1% of the standard group ($p < 0.001$), achieved a target diastolic blood pressure of < 85 mmHg. These findings confirm that it does appear to be easier to control and maintain diastolic blood pressure than systolic blood pressure.

Gaede et al (2003) suggested that participants in trials are motivated, but despite this less than half their patients reached the blood pressure target (< 130/80 mmHg). It has been suggested (JNC V1 1997, Graves 2000) that in some patients, normal blood pressure cannot be achieved despite prolonged antihypertensive treatment and such patients have treatment resistant hypertension (Setaro and Black 1992, Graves 2000, Borzecki et al 2005). As discussed previously, to achieve the desired reduction in

blood pressure (< 130/80 mmHg), most diabetic patients with hypertension will require two, three or four anti-hypertensive agents (Kaplan 2001). Data from this study showed that 45.7% of patients in the intensive group and 25.0% in the standard group required three or more anti-hypertensive agents to control their blood pressure (Table 4.3.7). In addition, there was increased prescribing of and more patients on the maximum dose of ACE inhibitors, Angiotensin Receptor Blockers and Alpha Blockers (Table 4.3.5).

It has been suggested that nurse-led clinics are more effective in attaining blood pressure targets than standard primary care for diabetes. Denver et al (2003) used a target of < 140/80 mmHg, compared with this study, where the target was < 130/80 mmHg. However, when the data using the BP target of 140/80 mmHg was compared, data in the current study showed consistently higher levels of attainment of systolic (71.3% v 38%) and diastolic (75.5% v 50%) blood pressure targets in the intervention group than Denver et al (2003). This suggests that blood pressure targets are more likely to be attained in a hospital setting in both intensive and standard groups. Denver et al (2003) showed that the intervention group were nearly six times more likely to have their treatment regimen adjusted and this rigorous application of the guidelines in the context of nurse-led management appears to be the key to greater improvement. In the research reported here substantially more patients in the intensive group had changes in treatment, increasing the doses of current medication or addition of further agents than in the standard group. It can be seen that 45.7% of patients in the intensive group had four or more blood pressure interventions compared with 4.3% in the standard group (4.3%)(p 0.001) (Table 4.3.9). In fact, in the intensive group, 6.4% of patients had 7 interventions, 3.2% had 8 interventions and 2.1% of patients had 11 interventions.

5.2.3 Dyslipidaemia

As discussed previously, dyslipidaemia contributes significantly to atherosclerotic disease in patients with type 2 diabetes (Fontbonne et al 1989). Several large-scale clinical trials, including 4S and more recently HPS, have clearly demonstrated the benefits of statin therapy in reducing cardiovascular events (Krentz 2003). Until recently there were no real data on the role of lipid lowering in the primary prevention of coronary heart disease (CHD) in diabetic patients. However, as

discussed earlier, the CARDS study (Colhoun et al 2002) has made an important contribution to the evidence base for lipid lowering in type 2 diabetes. The Heart protection Study (2002) and the lipid-lowering arm of the ASCOT trial **(**Sever et al 2003) recently added considerably to this evidence.

In an audit carried out in 2001 in the acute care setting in which this study took place, 60% of patients had dyslipidaemia (Sherlock et al 2006). In the current study (Table 4.2.1), at the beginning of the study, a high percentage of patients with dyslipidaemia, 51.9% in the intensive group and 55.8% in the standard group, were already at the recommended target (< 4.8mmol). This indicates that standard management of dyslipidaemia in the acute care setting of this study is better than many clinical trials. At the end of the study the intensive group had a significantly higher number of patients at target (84.8%) compared with the standard group (63.6%). Again, if looking at the change in total cholesterol during the study (Table 4.4.3), 41.8% patients in the intensive group and 19.5% in the standard group whom at the start of the study, were > 4.8 mmol reduced their cholesterol to < 4.8 mmol/L by the end of the study (p 0.011). When looking at the less conservative target of < 5 mmol, the data from this study, which showed that 88.6% of patients in the intensive group and 74.0% in standard group achieved a cholesterol of < 5mmol/L compares favourably with other studies such as (New et al 2003), who reported lower target success of 53.3%.

The improvement in cholesterol and LDL cholesterol in this study may be due to the fact that 96.2% of patients in the intensive group and 87% in standard group were on statin therapy by the end of the study. Looking at the change in statin therapy between groups there was an increase in the number of patients in the intensive group who commenced statin therapy (22.8%) compared with the standard group (9.1%) (Table 4.4.5). In addition, 27.8% in intensive group and 20.8% in standard group were on maximum statin therapy. There were substantially more changes in therapy, included increasing the dose of current therapy or changing to a different agent in the intensive group. Also, 44.3% of patients in the intensive group had 2 or more lipid interventions during the study compared with 7.8% in the standard group (p <0.001) (Table 4.4.6). As mentioned previously, although HDL cholesterol is a powerful predictor of CVD in patients with diabetes (ADA 2004) and triglycerides are an

independent risk factor for the development of atherosclerotic disease in patients with diabetes (Fontbonne et al 1989) there was no real impact made on either of these two risk factors in this study. Possibly additional medication, i.e. fibrate therapy, which might have been beneficial in reducing triglycerides and HDL-c, were not used as often as might have been warranted.

Current guidelines for diabetes emphasise the importance of good glycaemic control for all diabetic patients, but do not generally recommend initiating statin therapy unless LDL-c levels are higher than about 3-3.4 mmol/L (NCEP 2001, ADA 2002 and 2003). However, NCEP (2001) do recommended that LDL cholesterol concentration should be reduced to below 2.6 mmol/L in patients with existing coronary disease. The HPS (2003) now provides definitive evidence that lowering LDL cholesterol to below 2.0 mmol/L in people with diabetes, reduces macrovascular disease risk by approximately 25%. As mentioned previously, the NCEP in conjunction with the American Heart Association and the American College of Cardiology subsequently introduced a more aggressive LDL cholesterol target of less than 1.8 mmol/L for patients with diabetes who have previous cardiovascular disease (Grundy et al 2004) and more recently the ADA (2005-2007) have reiterated this recommendation. The TNT study **(**Shepherd et al 2006) added to the body of evidence (HPS 2002, Cannon et al 2004, Koren and Hunninghake 2004, Nissen et al 2004, LaRosa et al 2005) indicating that lowering the LDL-c to values well below current recommended levels with more intensive statin therapy is associated with additional cardiovascular benefit. Rajagopalan et al (2007) suggest that more effective and well-tolerated treatments, including combination stain therapies, are needed so that patients can reach the more stringent JBS 2 (2005) cholesterol goal of < 4 mmol/L.

Shepherd et al (2003) suggest that more needs to be done to improve the adoption and adherence to existing guidelines in clinical practice, as failure to use guidelines appropriately may put patients at risk of increased morbidity and mortality. In addition, Erhardt and Hobbs (2007) suggest that there is a need for improved communication regarding the importance of cholesterol lowering in addition to exploring the perceived barriers to achieving guideline goals among physicians. As

Heidrich et al (2005) demonstrated, there was a clear link between physicians' knowledge of guidelines and improved treatment of cardiovascular risk factors such as smoking, obesity and elevated LDL-c. However, Shepherd et al (2003) also suggest that guidelines should not be rigidly applied without using clinical judgment and knowledge of the patients' medical status, as patient safety is important in the choice of CVD prevention strategies.

5.2.4 Glycaemic control

Currently glycaemia is assessed by the use of self-monitoring of blood glucose and HbA1c, which provide different but complementary information (Saudek et al 2006). The ADA (2006) recommendations suggest that to assess glycaemic control, patients should have HbA1c done at least twice yearly in those who are meeting targets, but quarterly in those who have had a change in therapy or who are not meeting glycaemic targets. In reality, this is often not possible in clinical practice, due to the increasing number of patients with type 2 diabetes, time constraints, staff shortages and lack of resources. In the acute care setting of this current study, patients with type 2 diabetes in general, have their HbA1c measured yearly. However, if at their OPD visit glycaemic control has not been achieved, they may be given an appointment for review in the diabetes day centre.

As type 2 diabetes is characterised by a progressive decline in β-cell function, treatment needs to be adjusted regularly and usually results in combination therapy (Heine et al 2006, Vervoort and Tack 2007). The development of new classes of glucose-lowering medications has expanded the treatment options for type 2 diabetes, but has also introduced more uncertainty regarding which treatment option is the most appropriate (Vervoort and Tack 2007). Nathan et al (2006) and the ADA (2008) suggest that an HbA1c $\geq$ 7% should encourage the healthcare provider to initiate or change therapy with the goal of achieving a level as close to the non-diabetic range as possible (Heine et al 2006, Vervoort and Tack 2007). However, it has been suggested (Goudswaard et al 2003, Dijkstra et al 2005) that despite currently available treatment options, 50% of patients are not meeting glycaemic targets in clinical trials.

At the start of this current study 41.5% in intensive group and 34.0% in the standard group had a HbA1c level < 6.5%, indicating that standard management of glycaemic

control in the acute care setting of the study was better than many randomized controlled trials (Table 4.5.2). It can be seen though, that at the end of the study, despite intensive management of glycaemic control, only 52.1% of patients in the intensive group and 33% in the intensive group achieved the target of < 6.5% (Table 4.5.2). If looking at the change in glycaemic targets during the study (Table 4.5.3), 19.1% of patients in the intensive group and 9.6% in the standard group whom at the start of the study were > 6.5%, had reduced their HbA1c to < 6.5% by the end of the study. In the Steno-2 study (Gaede et al 2003), despite the fact that participants in their trial were motivated, less than a fifth of patients reached the HbA1c target of (<6.5%). It is difficult to ascertain why the HbA1c results obtained in the current study were better than the Steno-2 study, but possibly the nurse-led aspect with titration of medication at each visit if targets were not met, may have contributed to these results. Results from Taylor et al (2003) showed that 43% of patients in their intensive group v 25% of patients in the standard group reached a target HbA1c < 7.5%. Whereas, at the end of the current study, 66% patients in the intensive group and 51.1% in the standard group attained a HbA1c level < 7%. As mentioned previously, there was no significant difference between the groups in this study with regard to diabetes treatment and only eight patients in the intensive group started insulin in combination with Metformin, but as can be seen in Table 4.5.6, there were more changes in treatment in the intensive group.

More stringent targets have recently been set with respect to HbA1c (Lebovitz et al 2006, Ryden et al 2007). Clinicians need to set individual goals for each patient, taking into account their co-morbidities, age and their personal circumstances, such as whether they are elderly and possibly living alone. The results from this current study show that it is possible to achieve a target of <6.5% in a high percentage of patients. However, it can be seen that despite the fact that 36.2% of patients in the intensive group (Table 4.5.6) had three or more glycaemic interventions, included increasing the dose of current therapy, or adding another agent, only a small percentage of patients were commenced on insulin, either alone or in combination with oral hypoglycaemic agents (Table 4.5.4). The policy in the acute care setting of this study for initiating insulin therapy is based on HbA1c >7 %, similar to the Steno 2 Study (Gaede et al 2003). However, as the more recent targets suggest glycaemic target of <6.5%, it would appear that we should possibly be initiating insulin at an

earlier stage. This would have resource implications as patients need a lot of support and follow up when starting insulin, either in groups or on an individual basis. Hypoglycaemia is a significant complication of diabetes therapy (Miller et al 2001), which is more common in patients who are on insulin therapy but does occur with oral hypoglycaemic agents. As mentioned previously, recurrent hypoglycaemia can place a huge burden on relatives and carers of the elderly (McAuley and Frier 2001). In this current study 55.9% of patients were > 60 years (Table 4.2.2) and a number of these patients were living alone. It is important therefore, that individualised vascular risk targets should be set for patients, taking into account the person's age, lifestyle and other co-morbidities (Winocour 2002). Patients, particular the elderly, need to be advised about the effect and side effects of their medication, particularly if there is a risk of hypoglycaemia. A study by Browne et al (2000) found that only 10% of patients in the study who were on sulphonylureas knew that hypoglycaemia was a possible side effect. While Dunning and Manias (2005) found that 93% of participants in their study were given information about how and when to take their oral hypoglycaemic medication, however, only 37% were given information about side effects. In this current study, when patients were given any medication the side effects were explained to them and they were advised if they had any side effects to contact the vascular intervention nurse.

McMahon and Dluhy (2007) suggest the best approach for initiation of insulin therapy in patients with type 2 diabetes, on oral hypoglycaemic agents, is to continue with Metformin and add a basal insulin, but sulphonylureas should generally be stopped. The recent 4-T study mentioned previously (Holman et al 2007) adds to the available literature on insulin initiation and aimed to bring HbA1c level to 6.5% or less. However, the dosing and titration algorithm for insulin is just as important as the type of insulin chosen (McMahon and Dluhy 2007). Therefore it is vital that the healthcare professional looks at each patient individually, as in the elderly, basal bolus regime may not be suitable, but once a day or twice a day may be more suitable. Physicians need to take an active role in addressing or eliminating the barriers to insulin treatment (Campos 2007), by informing patients that hypoglycaemia is a side effect of treatment with insulin but that severe hypoglycaemia is rare (Miller et al 2001).

Self monitoring of blood glucose, as discussed earlier, is important particularly in patients on insulin therapy. As mentioned previously, patient involvement is critical to intensify glycaemic control and should involve frequent self-monitoring of blood glucose, adherence to treatment regimens and knowledge of the relationship between physical activity, diet and insulin (Davis and Alonso 2004). Patients need to communicate with the healthcare professional so together they can evaluate the blood results and if any changes in therapy are required that these changes are communicated effectively to the patient (Saudek et al 2006). During the study patients were encouraged to contact the vascular intervention nurse if their readings were abnormal on a regular basis so that required changes in treatment could be made. It is important that patients are taught to self adjust their insulin doses, where possible, with the use of simple guidelines (Riddle et al 2003). In this way patients have more control of what is happening on a day to day basis, with regard to diet and exercise and thereby can plan their regime therefore, in theory, reduce the risk of hypoglycaemia. During the study, patients were given an information sheet regarding adjusting of insulin, also how to adjust when exercising was discussed. Where possible patients were encouraged to self-titrate, however, in those patients who were unable to self-titrate, the vascular intervention nurse advised the patient of what dose of insulin to take.

5.2.5 Lifestyle issues

As many of the complications associated with diabetes are modifiable, lifestyle changes are an important aspect of diabetes care. As mentioned previously, Gaede et al (2003) targeted diet, exercise and smoking in their study. In the current study, lifestyle modification played an important part of the study. As discussed earlier, patients in the standard group were seen yearly in OPD where changes in medication or lifestyle advice could potentially be given, whereas patients in the intensive group were seen in OPD and by the vascular risk intervention nurse every 2 to 3 months. As seen (Table 4.10.1), substantially more patients in the intensive group had two or more diet (51.1% v .0%, $p < 0.001$) and exercise (45.7% v .0%, $p < 0.001$) interventions than the standard group. In the acute care setting of this study, patients are seen at diagnosis by the dietician and thereafter at the patient or healthcare professionals request, which is not an ideal situation for patients with type 2 diabetes, who should be seen at least every 2 years by a dietician, to reinforce dietary advice.

Diabetes is different from most other chronic illnesses in that many of its complications are modifiable or preventable with good clinical treatment. As discussed previously, behavioural and psychosocial issues are critical to good diabetes care (Glasgow and Osteen 1992, Fisher et al 1996, Lorenz et al 1996). In our study, as seen (Table 4.10.1), patients required a lot of psychological input, (52.1%) in the intensive group and (16%) in the standard group, ranging from support, advise, listening and counselling. There is no psychologist currently attached specifically to the diabetes service in the current study. However, patients have access to a social worker attached to the service, who does counsel patients and if required refers them to other relevant disciplines. In addition, there is a psychiatric outpatient service in the hospital. It is hoped in the future that a psychologist will be appointed to work with our diabetes service. This is vital, because as mentioned previously, behaviour outcomes were stronger predictors of mortality among diabetes patients (Davis et al 1988). For this reason, patient empowerment and setting of achievable goals is therefore very important in promoting self-care in diabetes.

5.2.6 Limitations of the study

It is difficult to identify and evaluate whether it was the frequency of visits, the method used to communicate information to the patients (verbal and written information), the type of interaction (one to one), with same nurse attending to the patient, or whether it was a combination of these interventions, which was responsible for the substantial risk reductions seen in the intensive group of the current study. This was also a problem identified by Gaede et al (2003), who felt that the design of their study made it impossible to identify which multifactorial intervention was responsible for the improvement in outcomes in the intensive arm of their study. This might be an area for future research, as it would be beneficial to try and ascertain what aspect of intensive management in patients with type 2 diabetes is the most beneficial.

5.3 Vascular risk factor questionnaire

A summary and discussion of the main findings in relation to vascular risk factor knowledge, both patients and healthcare providers, is presented in this section

5.3.1 Vascular risk factor knowledge

Boynton (2004) suggests that understanding your study group is the key to getting a good response to a questionnaire and Rose and Barker (1978) suggest that a response rate of 80% should be a minimum for epidemiological studies. In quantitative research, the response rate is important as it affects the extent to which it can be said that the results are gathered from a representative sample (Coates 2004). There was a very high response rate to the questionnaire (75%), which was very positive, as in general questionnaires have a low response rate. This may be due to the fact that a stamped addressed envelope was enclosed with the questionnaire. In addition, the nurse had a good rapport with the patients who on completion of part 1 of the study, wished to remain in the study.

Overall, the results from the knowledge questionnaire were disappointing in that they did not clearly show that the intensive group of patients had more knowledge of vascular risk factor targets than the standard group. However, the results did indicate that knowledge of vascular risk targets was far from ideal in this group of patients. A surprisingly high number of the total combined group of patients, did not know what ideal blood pressure (67.2%), cholesterol (65.1%) or HbA1c (68.1%) should be, with no significant difference between the groups. However, a high percentage of patients in both groups were aware that heart disease (89.2%) and stroke disease (82.8%) are a problem associated with diabetes, with no significant difference between the groups.

5.3.2 Blood pressure knowledge

A high percentage of patients in this study (91%) were aware that blood pressure control is important in the treatment of diabetes, 55/62 (88.7%) in the standard group and 56/50 (93.3%) in the intensive group (Table 4.13.1). This appears very different from a study by Petrella and Campbell (2005) who found that 80% of patients were unaware of the association between hypertension and heart disease. Data from the IHF (2006) survey also reveals that 45% of people aged 50-64 years were unable to estimate what a normal blood pressure reading should be. There was a high level of awareness of the factors contributing to high blood pressure with 85-95% identifying weight as a problem, and 92% being aware that heart attacks and strokes could be caused by high blood pressure. This shows a high knowledge of risk of heart attack and stroke rising from high blood pressure. However, despite the fact that a high

percentage of patients interviewed may have had hypertension, even if unaware of same, not many patients were able to identify targets in this general Irish population. As mentioned previously Stewart et al (2005b), found that many patients with type 2 diabetes who had raised blood pressure were not aware of the increased importance of achieving good blood pressure control.

As blood pressure is such an important component of the treatment of diabetes, there were a number of questions relating to blood pressure in the risk factor questionnaire sent to patients following the current study (Table 4.13.1). Patients in both groups were aware of the importance of blood pressure control in the treatment of diabetes, due to the fact that in the acute care setting of the study the patients are advised about the importance of blood pressure control, also, during the study, blood pressure was discussed with patients in the intensive group at every visit, and those patients in the standard group who had elevated blood pressure were advised to go to their GP to have it checked. However, the results were disappointing as patients did not appear to have retained the information given about target blood pressure (<130/80 mmHg), as 67.2% of patients did not know what their ideal blood pressure should be, with only slightly more patients in the intensive group aware of the ideal blood pressure (37.9% v 28.4%). As discussed earlier, little is actually known about patient's understanding of blood pressure (Stewart et al 2005b), or patient awareness of blood pressure targets, especially among those patients with established heart disease. Cheng et al (2005b) found that only 48.9% of all patients could correctly name targets for both systolic and diastolic blood pressure values. They concluded that despite national public health campaigns run in the United States to increase awareness of high blood pressure and the fact that the JNC 1997 and Chobanian et al (2003) have specifically recommended that physicians educate patients about their blood pressure levels and try to encourage patients to participate in reaching these goals, current blood pressure education efforts appear inadequate.

5.3.3 Cholesterol knowledge

Looking at the results of the questionnaire with regards to ideal target levels for cholesterol (Table 4.14.1), it is of concern that 65.1% of patients did not know what the ideal cholesterol should be (<4.8 mmol/L), with only slightly more patients in the intensive group aware of the ideal cholesterol (41.4% v 29.4%). In contrast, Cheng et

al (2005a) found 50% of patients could name targets for total cholesterol. It is difficult to ascertain the reason for this perceived lack of knowledge re ideal cholesterol target level. However, it is possibly due to the fact that cholesterol is not discussed as often with patients as blood pressure is discussed. One surprising result that emerged from the questionnaire was that only 94/121 (77.7%) of respondents said they were on cholesterol medication (Table 4.20.1), with more patients in the standard group 54/63 (85%) saying they were, as opposed to 40/58 (69%) in the intensive group. Whereas in the randomised controlled trial aspect of the study, of the 156 patients who had dyslipidaemia, 96.2% of patients were on cholesterol medication in the intensive group as opposed to 87% in the standard group (Table 4.4.4). This discrepancy in the questionnaire results may be due to the fact that only 121 respondents replied to this question, whereas 179 questionnaires were sent out or possibly some of the respondents who answered this question may not have had dyslipidaemia and therefore would not be on medication. Again, it is difficult to understand why there is quite a sizable proportion of people unaware of their cholesterol medication, but it may be explained by the fact that when doctors prescribe medication in the outpatients clinic, patients often don't ask what the medication is for.

5.3.4 Glycaemic control knowledge

Looking at the results of the questionnaire with regards to ideal target levels for HbA1c, it is of concern that 68.1% of patients did not know what ideal HbA1c should be (Table 4.15.1), however, more patients were aware of their ideal target in the intensive group (40.4% v 25.0%). This finding is in contrast to a nationwide survey run by the DFI (2005), entitled "Life's better under 7", which found that 80% of people know the recommended health A1c target level and 74% knew their current HbA1c and 71% had discussed their HbA1c level with their doctor or nurse. The DFI (2005) suggested that ongoing education campaigns are vital for continually encouraging people with diabetes to manage their condition more effectively.

A study by Jabbar et al (2001) found that only 60.0% of patients were aware of target blood glucose levels for optimal control, but in the current study 77.1% of patients were aware of what their ideal blood sugar should be when doing home blood glucose monitoring (between 4-8 mmol/l) (Table 4.15.1). This comprised 72.5% in the standard group with a higher number in the intensive group (82.3%). This is

probably due to the fact that when patients attend the diabetes centre their blood glucose readings are regularly reviewed and the results discussed, also patients are advised what the target blood glucose should be. Possibly there was not as much emphasis is placed on the target HbA1c. The positive results regarding awareness of ideal blood glucose indicate that patients appear to retain more information when the information is given on a regular basis.

An interesting finding from the questionnaire was that of those patients on treatment which could potentially cause hypoglycaemia, 70.7% of patients did not know how to treat a hypo (Table 4.12.2). This is disappointing as during the study, hypoglycaemia was discussed with all patients in the study who were on treatments which could potentially cause hypoglycaemia, plus they were given an information sheet regarding causes and treatment of hypoglycaemia. These findings indicate that ongoing education of patients taking insulin or sulphonylureas, regarding the symptoms and most appropriate treatment of hypoglycaemia is required.

5.3.5 Medication knowledge

As suggested by Donnan et al (2002) poor compliance with medication is a major problem in the treatment of diabetes, as patients are often on a number of medications for blood pressure, cholesterol and glycaemic control and suggested that once daily administration of medication would improve adherence rather than multiple agents. In addition, in the AUDIT study (Leitre et al 2006), patient compliance was seen as the most commonly perceived barrier to attainment of lipid goals. However Cramer (2004) found that the overall rate of adherence with oral hypoglycaemic agents was 36 – 93% in retrospective and prospective studies, with poly pharmacy and multiple daily dosing regimes being two of the main issues relating to non-adherence. Cramer (2004) suggests that failure to reduce HbA1c levels may be due to fact that patients are non compliant with medication rather than medication not being effective and that rather than increasing the dose, changing medication, or adding further drugs/ insulin, patients should be counselled on how to improve adherence to the existing medication.

In the current study, of those patients who were on medication for either hypertension or dyslipidaemia, a high percentage (80.4% – on blood pressure tablets (Table 4.19.1)

and 78.8% – on statin therapy (Table 4.20.1)) said they never forget to take their medication. Nevertheless there is still a sizeable minority of patients who are not compliant with their medication. There are a number of possible reasons for this non-compliance, namely poor memory and maybe patients were unsure which tablet was for which disease. Browne et al (2000) found that 20% of patients forgot to take their tablets once a week, while Dunning and Manias (2005) found that 20% regularly forgot to take their medication. Good (2002) suggests that when starting new medication, patients especially the elderly, should receive education about the medication, indications for use, instructions for taking it, common side effects and potential serious adverse events, thereby enhancing compliance. Again, education such as this which would be beneficial, takes time and in many cases is not given to the patient, due to time-constraints in the outpatient clinic.

Williams et al (2007) suggest that written information regarding hypoglycaemic medication is a better way of educating patients about their medication. Relying on verbal information is not ideal as it may vary, depending on the knowledge of the healthcare professional and the patient's ability to recall information. Browne et al (2000) suggest that the provision of drug information sheets at the time of the first prescription, from those prescribing medication, would provide consistent and appropriate information, which if backed up by written information and verbal advice by pharmacists would mean that patients would not be relying on their ability to recall verbal information given by their healthcare provider and may improve patient understanding and therefore compliance.

5.3.6 Patient knowledge of vascular risk factors

The questionnaire in the current study aimed to determine patient knowledge of heart disease and its relationship to diabetes in addition to knowledge of vascular risk targets, such as blood pressure, cholesterol and glycaemia. As mentioned previously, knowledge of heart, blood pressure and cholesterol is poor (Stewart et al 2005, Cheng et al 2005a, Cheng et al 2005b, Petrella and Campbell 2005 and Wagner et al 2005). Petrella and Campbell (2005) found that the majority of respondents were unaware of the association between hypertension and heart disease, however a high percentage of patients were aware that heart disease and stroke disease are a problem associated

with diabetes but less patients were aware that hardening of the arteries is a problem associated with diabetes.

Also, the American Diabetes Association and American College of Cardiology (2002) found that 2/3 of respondents did not consider cardiovascular disease to be a serious complication of diabetes. Jafary et al (2005) found that approximately 20.0% of patients could not identify a single risk factor for coronary heart disease. The survey conducted by Bairey Merz (2002) found that 68% of people with diabetes did not consider cardiovascular disease to be a serious complication of diabetes. Interestingly, almost 75.0% of patients said they asked questions about managing their diabetes and two-thirds of people with diabetes report discussing blood sugar control at some if not all visits to their healthcare provider. However, a sizable number of patients report that health care providers never discussed lowering blood pressure or lowering cholesterol, but the physicians reported that they discussed CVD risk factors with 88% of their patients with diabetes which indicates the difference between what patients and healthcare professionals remember from consultations (Bairey Merz 2002). Possibly the participants in the current study appeared to have a better knowledge of the relationship between diabetes and heart disease than in the other studies, because at diagnosis, patients are given education about diabetes and complications would be an aspect of this education. In addition, an explanation is given as to how high blood sugars, blood pressure and cholesterol can affect blood vessels.

Involving patients in decisions regarding their diabetes management is vital. However, it is also important to remember that not all patients may wish to take an active role in decisions regarding their diabetes care (Asimakopoulou 2007) and the healthcare professional must accept their wishes in this regard. A review of the literature by Norris et al (2001) involving diabetes education programmes, suggested that programmes which actively involve patients in the educational process appear more successful than teaching programmes which focus only on imparting knowledge. Rachmani et al (2005) found that patients who were in their active participation programme had better outcomes, which may have been due to intensified therapy and patients who were more compliant with treatment. Burden and Burden (2001) suggest that if patients learn that their blood pressure, cholesterol

and HbA1c are not on target, they are encouraged to ask their doctor why, to discuss whether lifestyle measures would be beneficial, and to discuss medication options, such as titration of current medication or addition of new medication.

A study by Stewart and Kendrick (2005) found that negotiating targets for blood pressure and HbA1c with people with type 2 diabetes does not routinely happen in primary care and that even when individual targets are negotiated, they are often unrecorded. They found that when annual reviews were undertaken by the practice nurse, targets were less often negotiated with patients and suggested that further work needs to be undertaken to explore the reasons for this. However, in the current study, lifestyle modifications were discussed with all patients in the intervention group and targets were negotiated and recorded in their chart. In addition patients were encouraged to ask questions regarding their diabetes management.

5.3.7 Patient preferences with regards to treatment

In the questionnaire, when respondents were asked how often they wished to be seen by the doctor in the outpatients, only 16.7% of the total group wished to be seen yearly, whereas 54% of patients wished to be seen every six months. These findings would have resource implications for the service in our acute care setting, as the majority of patients are only seen once a year in the outpatient clinic by the doctor.

When patients were asked how often they would like to be seen by the diabetes nurse, 39.8% would like to be seen every three months, with the same number wishing to be seen every 6 months. Also, when patients were asked if they felt it would be easier to control their diabetes by having a check up every two to three months, 76% of patients said “yes”, 81.7% in the intensive group and 70.8% in the standard group. Also, 74.4% of patients felt it would be easier to control their weight by having a check up every two to three months. These findings show that patients benefit from the increased visits with the diabetes nurse and also that patients wish to be seen more often. However, increasing the number of visits to the diabetes centre would have resource implications, as more staff would be required to facilitate this increased workload. This would be similar in many diabetes centres in Ireland.

In the questionnaire, when patients were asked if they had a choice, whom they would prefer to see regarding their diabetes care, 71% of the total group wished to be seen by "both hospital doctor and the nurse". This indicates that patients value the input of both the diabetes nurse and the doctor. Only 1 patient in the total group stated they would prefer to see their GP. In contrast, in a study by McHoy (2004), the majority of participants were happy with the care they received, irrespective of where they received it, but those who preferred to visit the diabetes centre rather than the GP, stated that they would also like to go to their GP if they could expect to receive the same level of specialist expertise that they received at the diabetes centre. Therefore it would appear that it is not the venue which is important, but the quality of service, expertise and confidence in the person providing the care.

Looking at the themes emerging from the qualitative responses in the results section, it would appear that in general, time pressures appear to be a problem in the outpatients department. In contrast, during the current study, patients were allocated 60 minutes for their first visit and 30 minutes for subsequent visits, which, when necessary was extended, if patients had problems or needed more time. Patients appeared to like the one to one interaction and continuity of care, as could be seen where 90.6% of patients felt it was beneficial to see the same nurse at each visit during the study.

5.3.8 Patient information regarding diabetes

When patients were asked, where they get most information regarding their diabetes, 75% of patients answered, "the diabetes nurse", 85.7% in the intensive group and 65% in the standard group, with only 18.1% of patients stating "the hospital doctor" and 1.8% of patients stating "the general practitioner". In contrast, in a study by Latalski et al (2002) the respondents felt that the leading source of knowledge about the nature of the disease and way of coping with it were, diabetologists (61.5%), nurses (33.8%) and GP (26.1%). The Diabetes Nurse Specialist is often the first person a patient would approach if they had problems, as seen in Williams et al (2007) where 53% of patients stated that they would approach the diabetes nurse if they had problems with their medication. In addition, Tham et al (2005) reported that 86.3% of information about diabetes was obtained from healthcare professionals in general, with other sources being television, radio programmes, books and the

internet. In the setting of the current study, the diabetes day centre is in the main, nurse led, with the doctor only in attendance if patients need to initiate insulin / medication or if a patient has a problem with a foot ulcer or other medical problem. Otherwise, all education is nurse-led, with the nurse deciding when the patient attends for future review visits. Also, the patients are advised to contact the diabetes centre if they have any problems associated with their diabetes. All patients are, where possible, seen yearly in the out-patient department for their annual review, which is where the doctor would have an input into their management.

When patients were asked if it was beneficial being in the study, despite the fact that patients in the standard group did not receive any education on lifestyle modification and vascular risk factors, 82.8% of patients found it beneficial being in the study. In the intensive group it was interesting that all patients found it beneficial. When asked whether they had more knowledge about diabetes after the study, again a high percentage, 82.4% in the standard group, and 96.7% in the intensive group, stated that they had more knowledge regarding diabetes. This may in part be due to the fact that areas such as hypoglycaemia, adjusting of insulin (where applicable) among other issues, were discussed in both groups. Once again, as our patients are only seen approximately once a year, the extra contact acted as a reminder and update of knowledge. In general patients felt they have received enough information regarding diabetes and the following areas; blood pressure (81.7%), cholesterol (79.5%), blood sugar control (95%), diet, weight reduction (96.8%), benefits of exercise (97.6%), alcohol (86.3%), risks of smoking (92.9%). Both groups were similar regarding the above, except with regards to blood pressure and cholesterol, where approximately 10% more patients in intensive group had received enough information.

It would be difficult to ascertain from the questionnaire how perception of receiving enough information matched patients' actual knowledge of these aspects, as not all patients' answered each question. Only 68.5% of patients in general felt that they had received enough information regarding the complications of diabetes, which leaves quite a high percentage who were either undecided or did not feel they had received enough information. Other studies (Ali et al 1998, Mohan et al 2005) have also found that patients do not appear to have adequate knowledge of the complications associated with diabetes. In the study by Oliveria et al (2005) it was suggested that

although general knowledge and awareness of hypertension was adequate in the population studied, patients did not fully understand the condition. Patient education programmes need to focus on the cardiovascular risk associated with hypertension (Alexander et al 2003, Oliveria et al 2005) but this needs to be combined into an education programme which address all aspects of vascular risk reduction in this high risk population who have type 2 diabetes mellitus. During the current study, all patients in the intensive group were given literature regarding vascular risk factors and hypertension, dyslipidaemia and all modifiable risks were discussed. Also, in the acute care setting of this study, the education programme for patients with type 2 diabetes does discuss the relationship between vascular risk factors and diabetes.

Active patient participation in their care is a critical factor in improving adherence to treatment (Aminoff and Kjellgren 2001). As mentioned previously, well-informed and motivated patients were more inclined to reach and maintain their vascular risk targets (Rachmani et al 2002, Tham et al 2004). When patients were asked in the current study if they felt it would be helpful to know the results of their blood pressure and blood tests at each visit, 93.8% of patients agreed it would be helpful in the management of their diabetes. This shows that patients wish to be involved and informed about their diabetes treatment and management. Glasgow (1997) suggests that it is important to ask patients whether they understand the recommendations given by their healthcare providers and whether they are receiving consistent messages from all members of the team. In addition, it is important to set individual goals with patients taking into account the patient and their lifestyle, these behavioural goals should be documented in the patient's notes and a copy of these goals should be given to the patient also. In the current study, at each visit, goals for modifiable risk factors (smoking, diet, exercise, glycaemic control) were set for each patient and these were recorded in the notes and revised as necessary. As diabetes is a chronic disease requiring continuing medical care and education, it is vital to raise awareness of the link between diabetes and cardiovascular disease so that patients are knowledgeable regarding the importance of vascular risk management in order to reduce cardiovascular complications (Bairey Merz et al 2002).

5.3.9 Limitations of the study

The questionnaire design was based on patient self reporting and there is no means of verifying whether the information given was accurate (Coates 2004), which is a limitation to this study. Also, there was a time lag between when patients finished the study and collection of the data via the questionnaire, therefore some of the information obtained may be flawed as patients may have received information from other sources in the intervening period. This may also explain why there was no significant difference between the standard and intensive groups with regards to knowledge in this study population. However, as there was a defined study population, a randomized sample of patients attending the diabetes service in the acute care setting of this study, the results of this study could be generalised (Coates 2004) to the wider population of patients in the acute care setting of the study. In addition, despite the high response rate (75%), there were still 25% of patients who did not return completed questionnaires. Also, not all patients answered each of the questions, which meant that it was difficult at times to obtain an accurate picture of total knowledge. Nevertheless, it is anticipated that the results of the questionnaire may identify possible gaps in our current diabetes service, such as education on vascular risks, diet and exercise programmes. In addition, it may guide areas for future development such as incorporating vascular risk target into our education session for patients. New and improved ways of imparting knowledge regarding type 2 diabetes and cardiovascular disease need to be explored, so that patients are given up to date information in a more user-friendly way.

5.4 Implications for practice

Randomised controlled trials have demonstrated the benefit of nurse-run clinics to achieve positive results on cardiovascular risk factors, however to achieve positive results, intensive intervention is needed and this requires a significant time and resource commitment, both for the patient and the health care professional (Riley 2003, Taylor et al 2003, McLoughney et al 2007). There are also additional costs for providing the intervention, including the cost of the nurse-care manager's time, the additional medication, laboratory costs incurred by using the management algorithms and costs related to higher rates of routine assessment and self-management (Taylor et al 2003). In the current study, one hour was allocated for the first visit and thereafter 30 minutes was allocated per patient per visit, which was extended if

necessary. In routine practice, it is often not possible to allocate this length of time per patient, with many patients only allocated 15 minutes per consultation.

The key issues leading to nurse-led success in cardiovascular risk management and motivating behaviour change in patients, include encouragement and support, counselling and lifestyle advice, information regarding treatment regimes, measuring and monitoring risk factors, in addition to having the time to listen to the patient (Wiles 1997, McHugh 2001, Wright et al 2001). As mentioned previously, standard diabetes care in our acute care setting, means that patients are seen once a year in OPD and possibly in the diabetes centre during the intervening year. As education needs to be reinforced on a regular basis, this is not the ideal situation. During the study, on each visit with the vascular risk nurse, education on hypoglycaemia, and adjusting of insulin (if appropriate), was given to both groups. However, as patients in the intensive group were seen every two to three months, more patients had three or more diabetes education interventions in the intensive group (62.8%) as opposed to the standard group (18.1%). Following on from the results obtained in the current study, the diabetes service have introduced a vascular risk nurse-led clinic to address the gap in the service and so hopefully impact on the growing problem of micro and macrovascular complications associated with diabetes. Vijan and Hayward (2003) suggest that goals should be individualised, with a realistic outlook that perhaps many patients with diabetes and hypertension will not achieve aggressive goals, despite taking three or four antihypertensive agents. As mentioned previously, in the current study, targets were set for each patient in the intensive group, taking into account the person as well as the disease. Also, in the acute care setting of the current study, glycaemic targets are set for each patient and negotiated in an effect to achieve targets HbA1c level and therefore reduce complications.

The results obtained in the questionnaire have implications for practice in the acute care setting of the current study. Diabetes education and treatment programmes need to provide education on not only hyperglycaemia, but also the associated risk factors of hypertension and dyslipidaemia. People with diabetes need to understand why their blood pressure and cholesterol levels are treated aggressively. They need to know the consequences of prolonged hyperglycaemia, including dangers of potential microvascular and macrovascular damage to the cardiovascular system, eyes, kidneys

and feet (Kester 2004). Teaching programmes need to be patient-centred, flexible and carefully structured, with thought given to the most effective timing and duration of the education programme (Kester 2004). Healthcare professionals who deliver diabetes education programmes need to have a sound knowledge base about the many problems associated with diabetes, and ideally it should be a multidisciplinary approach (Kester 2004). Currently in our acute care setting we are aiming to commence a structured group education programme for patients with type 2 diabetes, the Diabetes Education and Self-Management for Ongoing and Newly Diagnosed (DESMOND) programme. This will involve 6 hours of structured education, ideally within 2 weeks of diagnosis (Carey and Daly 2004). Structured education is an important step, as the literature shows that structured education improves metabolic control, well-being and quality of life in addition to proving dietary freedom (Harkin 2006). However, providing this form of education is costly (Kester 2004, Hill et al 2006), as staff have to be trained to deliver the programme, in addition, administrative costs would need to be factored into the cost of providing this type of education to patients. Education needs to be ongoing, reiterated and updated at appropriate intervals (Kester 2004) to aid retention of information.

Advanced Nurse Practitioner (ANP) posts are emerging in management of acute/chronic disease. According to Browne and Mooney (2006), although the roles of the clinical nurse specialist (CNS) and the advanced nurse practitioner interrelate in many ways, there are some fundamental differences in their functions and responsibilities. Currently there are three ANP posts accredited in the area of diabetes care. ANP's are ideally suited to play an integral role in the education and medical management of people with diabetes (Conlon 2001). An ANP post may be a future development in the acute care setting of this study, based on the results of the current study. Another area of nursing which is expanding and which will change the course of nursing management in the area of diabetes is the introduction of nurse prescribing (NCNM 2007). The ability to prescribe and adjust mediation is a valuable asset in caring for individuals with diabetes (Spollett 2003) and would be beneficial in running a nurse-led vascular risk clinic similar to that of the current study.

5.5 Recommendations for future research

Further studies need to be undertaken in Ireland and internationally, of longer duration, with one nurse managing all aspects of vascular risk reduction, to confirm the cost effectiveness of nurse-led clinics in secondary care. To date, many studies undertaken have been done in primary care with a nurse looking at one particular risk factor, such as hypertension. Studies need to be done using current internationally recommended targets for blood pressure, lipids and glycaemic control, as many of the previous studies used targets which have now been shown to be inadequate to halt the progression of microvascular and macrovascular complications which are associated with diabetes.

5.6 Conclusion

The major obstacles to providing effective diabetes care are presented by the large numbers of patients with diabetes and the challenging targets for BP, lipid and glycaemic control (New et al 2003). The addition of a nurse-led vascular risk clinic in conjunction with current treatment practice is one way of delivering the quality of care necessary to delay / prevent the progression of both microvascular and macrovascular complications of diabetes. The results of this current study add to the existing body of evidence indicating that a nurse-led clinic targeting lifestyle, smoking, hypertension, dyslipidaemia as well as hyperglycaemia, may be an effective way of achieving vascular risk reduction targets. The results obtained from the Vascular Risk Factor Questionnaire were however disappointing as they did not show overwhelmingly that intensive intervention meant that patients had more knowledge regarding vascular risk targets. However, this research provides valuable information regarding the lack of knowledge regarding blood pressure, cholesterol and glycaemic targets in this group of patients.

Nurse led clinics have many advantages, including the ability to see patients more regularly, a greater willingness to titrate medications and attention to lifestyle measures (Campbell et al 1998, New et al 2003, Denver et al 2003). However, for these clinics to be effective, a significant time and resource commitment is required. Diabetes education programmes need to incorporate education regarding diabetes and its relationship with cardiovascular disease. In addition, education needs to be

reinforced on an ongoing basis to aid retention of information over time. As a result of this current research, a nurse-led vascular risk clinic has been established in the acute care setting of this study. In addition, protocols have been devised which address the multifactorial aspect of diabetes management.

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APPENDIX 1

VASCULAR COMPLICATIONS OF DIABETES

Macrovascular complications (large vessels)

1.	Cardiovascular disease	-	Myocardial infarction, stroke
2.	Peripheral vascular disease	-	Amputation

Microvascular complications (small vessels)

1.	Nephropathy	-	Acute / chronic renal failure
2.	Retinopathy	-	Blindness, cataracts
3.	Neuropathy	-	Peripheral Diabetic foot ulcers Charcot foot
		-	Autonomic Impotence Gastroparesis

APPENDIX 2

ADA (2008) Vascular Risk Targets / Management

Blood pressure		Systolic BP	< 130 mmHg
		Diastolic BP	< 80 mmHg
Lipids	Patients without CVD	Patients > 40 years, with one or more CV risk factor, Statin therapy regardless of LDL-c Patients < 40 years with / without CV risk factors not achieving lipid targets should start therapy.	LDL-c < 2.6 mmol/L
	Patients with CVD	All patients should be treated with a statin	LDL-c < 1.8 mmol/L
			Triglycerides < 1.7 mmol/L
			HDL-c > 1.0 mmol/L (men) > 1.3 mmol/L (women)
HbA1c		Patients with diabetes, in general	< 7%
		Individual patients, as near normal as possible without significant hypoglycaemia	< 6%

Antiplatelet agents	Aspirin therapy 75 – 162 mg daily	Secondary prevention if history of CVD
		Primary prevention - aged > 40 years - Family Hx CVD - Risk Factors - Hypertension - Smoker - Microalbuminuria - Dyslipidaemia
	Combination therapy -Clopidrogel	Severe progressive CVD

APPENDIX 3

RECRUITMENT POSTER FOR PATIENTS

ATTENTION PATIENTS

If you have : -

- Type 2 Diabetes Mellitus for a year or more
- Are over 30 years of age
- Are on tablets or insulin

And have any of the following **: -**

- High blood pressure
- High cholesterol
- Have had a heart attack in the past

We would be interested in talking to you.

We are currently running a study which looks at improving the treatment of patients with type 2 diabetes mellitus, in order to reduce the risks of heart disease and stroke.

If you would like any more information, please ask any of Dr Thompson's team in the outpatient clinic, or ask to speak to **Jackie Mac Mahon, Diabetes Nurse Specialist, at 8092744 / 8092745**

Appendix 4

RECRUITMENT LETTER TO PATIENTS REGARDING THE STUDY

Dear

We are writing to invite you to participate in a research study. The aim of the study is to find out whether more frequent monitoring of patients with type 2 diabetes mellitus, who have high blood pressure or high cholesterol, will allow more effective prevention of heart disease and stroke.

We enclose a patient information sheet. If you agree to participate, we will ask you to sign a consent form. You will then be randomised into one of two groups. One group will be seen in the diabetic clinic as usual. The other group will be seen more frequently in order to control blood pressure and cholesterol as quickly and effectively as possible. The study will last one year.

Your participation is entirely voluntary, and your care will not be affected if you are unable to help.

I would be grateful if you could contact me, Jackie Mac Mahon at 8092744/5, to let me know if you would be interested in participating.

Yours sincerely

Dr Chris Thompson
Consultant

Jackie Mac Mahon
Diabetes Nurse Specialist

APPENDIX 5
PATIENT INFORMATION SHEET

Patient Information Sheet

Study Title

To establish the importance of a Cardiovascular Risk Factor Intervention Nurse in improving the ability to achieve cardiovascular risk factor targets in patients with type 2 diabetes mellitus.

Study explanation

You are invited to take part in a study that may be helpful in preventing heart disease, stroke in individuals with type 2 Diabetes Mellitus. Your participation is entirely voluntary (your choice). You do not have to take part in this study. If you choose not to take part, your care or future treatment will not be affected. If you agree to take part, you are free to withdraw from the study at any time, without having to give a reason. Withdrawing at any time will in no way affect your future health care.

The aim of the study is to find out whether by monitoring patients with type 2 diabetes mellitus who have risk factors for the development of a heart attack or stroke, such as high blood pressure or high cholesterol, more regularly, will allow more effective treatment of these conditions. A total of 400 patients who attend the Diabetes centre in Beaumont Hospital will be invited to take part in this study.

As with all medication, there is a possible risk that the medication may cause side effects. All medication used in this study is used on a regular basis and are not experimental medication. Depending on the type of medication ordered, some side effects may

include; dry cough, rash, abnormal liver function tests, and dry mouth. You will be screened for any side effects at each visit. Should you develop any side effects in the interim, please contact us at the numbers below or if unavailable, contact your GP.

The results obtained from the study may or may not be of direct benefit to your medical management. As with many clinical research projects, much of the benefit is for patients in the future. However, some benefit may be derived from the increased visits to the study doctor/nurse, which are required by the study.

During the study

If you agree to participate, you will be randomised to one of two groups – one group will be seen on average two monthly, and the other group will be seen as normal, once or twice a year in the outpatient's clinic. The study will last one year. At each visit, you will get your blood pressure measured and your weight. If your blood pressure is high you may be started on medication to reduce it, or if you are already on medication, this may be increased. We will take blood and depending on the results of these tests, you may require a change in your treatment.

The participants in this study have a right to privacy and all information that is collected during this study is strictly confidential.

APPENDIX 6
CONSENT FORM

Patient Name: Hospital Number:

Research Information

You are being asked to participate in a research study. The doctors at the Diabetes Unit in Beaumont Hospital are trying to establish the importance of a cardiovascular risk factor intervention nurse in improving the ability to achieve cardiovascular risk factor targets. In order to decide whether or not you want to be part of this research study, you should understand enough about the risks and benefits to make an informed judgement. This process is known as informed consent. This consent form gives detailed information about the research study, which will be discussed with you. Once you understand the study, you will be asked to sign this form if you wish to participate.

Participating in this research may be of no direct benefit to you. It will allow us to have a better understanding of the benefits of achieving cardiovascular risk factor targets in diabetes; and may therefore benefit people with diabetes in the future. Your participation is completely voluntary, and if you choose not to participate this will have no influence on your further care.

AGREEMENT TO CONSENT

The research project and the treatment procedures associated with it have been fully explained to me. I have had the opportunity to ask questions concerning any and all aspects of the project and any procedures involved. I am aware that participation is voluntary and that I may withdraw my consent at any time. I am aware that my decision not to participate or to withdraw will not restrict my access to health care services normally available to me. Confidentiality of records concerning my involvement in this project will be maintained in an appropriate manner.

I, the undersigned, hereby consent to participate as a subject in the above-described project conducted at Beaumont Hospital. I have received a copy of this consent form for my records. I understand that if I have any questions concerning this research, I can contact the doctors listed above. If I have questions concerning my rights in connection with the research, I can contact the Ethics (Medical Research) committee of Beaumont Hospital.

If you have any queries during the study you can contact Dr. Kevin Moore at 8093000, bleep 122, or S/N Jackie Mac Mahon at 8092744/5

After reading the entire consent form, if you have no further questions about giving consent, please sign where indicated.

Doctor ……..……. Date ……..

Signature of Subject …….. Date ……..

Appendix 7

RECRUITMENT LETTER TO PATIENTS REGARDING VASCULAR RISK FACTOR QUESTIONNAIRE

Dear

You participated in a Vascular Risk Study which aimed to find out whether more frequent monitoring of patients with type 2 diabetes mellitus, who have high blood pressure or high cholesterol, will allow more effective prevention of heart disease and stroke. Following on from the study, we are looking at patient knowledge of vascular risk factors and diabetes.

I enclose a Vascular Risk Questionnaire which I would be grateful if you would take the time to complete and return to me in the stamped addressed envelope.

Yours sincerely

Jackie Mac Mahon
Diabetes Nurse Specialist

APPENDIX 8

RISK FACTOR QUESTIONNAIRE

This questionnaire relates to the study you took part in regarding your diabetes care, which you finished in …….. I would be grateful if you would take the time to fill it in. <u>All information collected is anonymous and confidential.</u> It is being collected to obtain information about patient knowledge regarding diabetes and heart disease plus patient satisfaction regarding care. If you have any queries, please don't hesitate to contact me – Jackie Mac Mahon at 8092744/5. Many thanks for your time.

Section 1 **(Please <u>tick one box</u> per question)**

1. Male .....( )
   Female.....( )

2. Age group
   a) 30-39.....( )
   b) 40-49.....( )
   c) 50-59 .....( )
   d) 60-69.....( )
   e) Over 70 .....( )

3. How long have you had diabetes? …… years

4. Diabetes Treatment
   a) Diet controlled only .....( )
   b) Diet plus tablets .....( )
   c) Diet, tablets and insulin .....( )
   d) Diet and insulin only .....( )

(Please <u>tick one box</u> per question)

5. Your **<u>ideal</u>** blood sugar readings before meals should be:

a) Between 4-8 ..... ( )

b) Between 7-10 ..... ( )

c) Between 10-14 ..... ( )

d) Don't know ..... ( )

6. Your **<u>ideal</u>** HbA1c should be:

a) Less than 6.5 ..... ( )

b) Less than 7 ..... ( )

c) Less than 8 ..... ( )

d) Don't know ..... ( )

7a). Are you on insulin, Diamicron, Diamicron MR, Daonil or Amaryl YES ( ) NO ( )

b). If yes, how would you treat a "hypo"?

a) Lucozade or other sweet drink ..... ( )

b) Sweets/chocolate ..... ( )

c) Bread or biscuits ..... ( )

d) Lucozade plus bread or biscuits ..... ( )

e) Don't know ..... ( )

Section 2

8. Your **<u>ideal</u>** blood pressure reading should be:

a) Less than 130/80 ..... ( )

b) 140/80 ..... ( )

c) 150/90 ..... ( )

d) 160/90 ..... ( )

e) Don't know ..... ( )

(Please <u>tick one box</u> per question)

9a). Are you on blood pressure tablets? YES ( ) NO ( )

b). If yes, do you ever **<u>forget</u>** to take your blood pressure tablets?

a) Never.....( )

b) Once a day.....( )

c) Once/twice a week.....( )

d) More than once/twice a week.....( )

e) Once a month.....( )

10. Your **<u>ideal</u>** cholesterol reading should be:

a) Less than 4.8.....( )

b) Less than 5.8.....( )

c) Less than 6.8.....( )

d) Greater than 7.....( )

e) Don't know.....( )

11a). Are you on cholesterol tablets? YES ( ) NO ( )

b). If yes, do you ever **<u>forget</u>** to take your cholesterol tablets?

a) Never.....( )

b) Once a day.....( )

c) Once/twice a week.....( )

d) More than once/twice a week.....( )

e) Once a month.....( )

(Please <u>tick one box</u> per question)

12a). Do you smoke? YES ( ) NO ( )

b). If yes, how many cigarettes on average do you smoke per day?

a) Less than 5 ..... ( )

b) 5-10 ..... ( )

c) 10-20 ..... ( )

d) More than 20 ..... ( )

c) Have you recently received advice on giving up smoking? YES ( ) NO ( )

d) If yes, by whom

a) Doctor ..... ( )

b) Diabetes Nurse ..... ( )

c) Both doctor and nurse ..... ( )

d) Other (please specify) _____

Section 3 **(please answer each question)**

13. Which of the following statements are true or false?

	True	False	Don't know
a) Heart disease is a problem associated with diabetes			
b) Stroke disease is a problem associated with diabetes			
c) Hardening of the arteries is a problem associated with diabetes			
d) Smoking affects your blood vessels			
e) High cholesterol can affect your blood vessels			
f) Weight gain affects your blood pressure			
g) Stress affects your blood pressure			

(please answer each question)

14. How important are the following in the treatment of diabetes?

	A little	A lot	Don't know
a) Blood sugar control			
b) Reducing cholesterol			
c) Blood pressure control			
d) Diet			
e) Exercise			
f) Quitting Smoking			
g) Moderate alcohol intake			
h) Reducing stress			

15. I have received enough information regarding:

a) Blood pressure and diabetes

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

b) Cholesterol and diabetes

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

c) Blood sugar control and diabetes

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

d) Diet & weight reduction

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

e) Benefits of exercise

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

f) Alcohol consumption and diabetes

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

g)Risks of smoking and diabetes (where appropriate)

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

h) Complications of diabetes mellitus

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

Section 4 **(Please <u>tick one box</u> per question)**

16. It would be easier to control my diabetes by having a check up every 2-3 months

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

17. It would be easier to control my weight by having a check up every 2-3 months

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

18. It would be helpful to know the results of my blood tests and blood pressure at each hospital visit

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

19. All my questions were answered adequately regarding my diabetes care while on the study

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

20. It was beneficial to see the same nurse every visit during the study

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

21. I received enough emotional support during the study

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

21. I have more knowledge about diabetes after the study

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

(Please <u>tick one box</u> per question)

23. How often do you feel that you would like to be seen by the doctor in the outpatients' clinic?

a) Every 2 months ..... ( )
b) Every 3 months ..... ( )
c) Every 4 months ..... ( )
d) Every 6 months ..... ( )
e) Yearly ..... ( )
e) Never ..... ( )

24. How often do you feel that you would like to be seen by a diabetes nurse?

a) Every 2 months ..... ( )
b) Every 3 months ..... ( )
c) Every 4 months ..... ( )
d) Every 6 months ..... ( )
e) Yearly ..... ( )
e) Never ..... ( )

25. If you had the choice, whom would you prefer to see regarding your diabetes?

a) Hospital doctor only ..... ( )
b) Diabetes nurse only ..... ( )
c) Both hospital doctor and diabetes nurse ..... ( )
d) GP ..... ( )
e) No one ..... ( )

25b. Explain why

(Please <u>tick one box</u> per question)

26. Where do you get **<u>most</u>** information from regarding your diabetes? (please tick one)

a) Hospital doctor.....( )

b) Diabetes nurse.....( )

c) Diabetes Federation of Ireland.....( )

d) Internet.....( )

e) GP .....( )

g) Other (please specify) ----------

27. It was beneficial to me being in the study

Strongly agree	Agree	Undecided	Disagree	Strongly disagree

27b. Why?

_____

_____

_____

_____

_____

_____

Please comment on any other issues to do with the study that have not been covered in this questionnaire. Many thanks for your time.

APPENDIX 9
GLOSSARY

ADA	American Diabetes Association
ALLHAT	Antihypertensive and Lipid Lowering Treatment to Prevent Heart Attack Trial
ASCOT	Anglo-Scandinavian Cardiac Outcomes Trial
Atherosclerosis	A progressive narrowing and hardening of arteries over time, which impedes normal blood flow and is often associated with clot formation. It is caused by formation of atheroma (plaques comprising cholesterol, old muscle cells, blood clot platelets and fibrous tissue) on inner surface of the arteries.
BP	Blood pressure
CARDS	Collaborative Atorvastatin Diabetes Study
CARE	Cholesterol and Recurrent Events
CAD	Coronary artery disease
CHD	Coronary heart disease
DBP	Diastolic blood pressure
DM	Diabetes mellitus
LDL-c	Low-density lipoprotein cholesterol
LIPID study	Long-term Intervention with Pravastatin in Ischaemic Disease
HDL-c	High-density lipoprotein cholesterol
HbA1C	A compound formed from haemoglobin and glucose. Erythrocytes are freely permeable to glucose. The level of glyco-haemoglobin in a blood sample provides a glycaemic history of the previous 120 days, the average erythrocyte lifespan. HbA1c most accurately reflects the previous 2-3 months of glycaemic control.
HOPE	Heart Outcomes Prevention Evaluation

HOT	Hypertension Optimal Treatment
HPS	Heart Protection Study
Insulin Resistance	Inability of the body to use its own insulin.
JNC	Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure.
MI	Myocardial infarction
NCEP ATP 111	National Cholesterol Education Program Adult Treatment Panel
PROSPER	Prospective study of Pravastatin in the Elderly at Risk
SBP	Systolic blood pressure
SHEP	Systolic Hypertension in the Elderly Program
4S	Scandanavian Simvastatin Survival Study
TG	Triglycerides
UKPDS	United Kingdom Prospective Diabetes Study
WOSCOPS	West of Scotland Coronary Prevention Study