The effectiveness of screening for type 2 diabetes within a community pharmacy setting

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Abstract

The overall aim of the programme of work was to evaluate the acceptability and feasibility of pharmacy based screening programmes for type 2 diabetes. A key component of this was to summarise pharmacists’ views and experiences relating to the acceptability and feasibility of the screening methods chosen, as well as gathering more general views and experiences of the provision of screening services by community pharmacists.

A systematic review and meta-analysis was undertaken in order to evaluate the level of success of previous screening interventions initiated by community pharmacists. A pragmatic randomised controlled trial using existing screening tools for type 2 diabetes was then carried out: the Pharmacy Based Screening for High Risk Individuals using Stepwise Methods (PRISM) study.

Key Findings:

- Previous studies have shown that pharmacy initiated screening for cardiovascular disease risk factors such as diabetes can identify a high proportion of those who are at ‘high risk of type 2 diabetes and cardiovascular disease. However, studies are often of low quality and limited by incomplete follow up and poor reporting of methods.
- The screening methods used in the PRISM study resulted in a high screening yield compared to other similar opportunistic methods of screening.
- The screening methods used were acceptable and feasible from a pharmacist’s point of view, and resulted in a number of benefits to pharmacies. These benefits included: improved job satisfaction and morale within the pharmacy team, improvements in diabetes knowledge and consultation skills and improved relationships with customers.
- The qualitative study carried out highlighted the variety of work and the different roles occupied by pharmacists and pharmacy staff when carrying out screening for type 2 diabetes.

Based on the findings of this programme of work, implications for future research and clinical practice are provided in order to increase the provision of screening for type 2 diabetes to improve uptake in people who are at highest risk.
List of publications arising from this programme of work

Review articles


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I am extremely grateful for the hard work of the pharmacists and their teams who participated in the PRISM study and subsequent qualitative study. I cannot thank all of them by name but without their continued support and hard work the study would not have been possible. I would also like to thank colleagues from the Primary Care Research Network for their support in facilitating timely collection of follow up data from practices.

I would like to give thanks to all of my colleagues from the Department of Health Sciences for their friendship and support during the early phase of my career as a junior researcher. I feel privileged to be working with such talented individuals who I hope I will continue to learn from, in years to come.

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List of abbreviations used in this thesis

Abbreviations are written in full the first time they are used in the text.

ADA American Diabetes Association
BIPQ Brief Illness Perception Questionnaire
BME Black and Minority Ethnic
BMI Body Mass Index
CHD Coronary heart disease
CI Confidence Intervals
CTU Clinical Trials Unit
CV Cardiovascular
CVD Cardiovascular Disease
DoH Department of Health
DRN Diabetes Research Network
DSN Diabetes specialist Nurse
EQ-5D EuroQol Quality of Life Scale
FPG Fasting Plasma Glucose
GCP Good Clinical Practice
GP General Practitioner
HbA1c Glycosylated Haemoglobin
HCP Health Care Professional
IDDM Insulin Dependent Diabetes Mellitus
IFG Impaired Fasting Glucose
IGR Impaired Glucose Regulation
IGT Impaired Glucose Tolerance
IMD Index of Multiple Deprivation
IQR Inter-Quartile Range
LPC Local Pharmacy Committee
LSA Leicester Self-Assessment Risk Score
MI Myocardial Infarction
MUR Medicine Use Review service
NHS National Health Service
NICE National institute for Health and Care Excellence
NIDDM Non-Insulin Dependent Diabetes Mellitus
NMR New Medicine Review service
NPT Near-Patient Test
NSC National Screening Committee
NS-SEC National Statistics Socio-economic Classification coding tool
OGTT Oral Glucose Tolerance Test
PCRN Primary Care Research Unit
PhD Doctor of Philosophy
PRISM Study Pharmacy Based Screening of High risk individuals using stepwise methods
PSA Prostate Specific Antigen
QC Quality Control
RBG Random Blood Glucose
RCT Randomised Controlled Trial
SA South Asian
SD Standard Deviation
SOP Standard Operating Procedure
T2DM Type 2 diabetes Mellitus
UK United Kingdom
US United States
USPSTF United States Preventative Services Taskforce
VAS Visual Analogue Scale
WE White European
WHO World Health organisation
Chapter one. Introduction and rationale for the programme of work

1.1 Chapter overview

This chapter provides the background and overall rationale for the thesis. Firstly, an introduction to type 2 diabetes is provided (section 1.2), including trends in prevalence of type 2 diabetes related mortality and morbidity (section 1.3). Secondly, information is outlined on the burden of diabetes both to the patient and to the health service as a whole, with an emphasis on cases of undiagnosed type 2 diabetes (sections 1.4 and 1.5). The chapter then provides a discussion of past and current methods of screening for type 2 diabetes, in order to address the issues caused by undiagnosed type 2 diabetes (section 1.6). Section 1.8 presents a summary of the determinants of both initial screening uptake by participants, and uptake of confirmatory testing once identified as ‘high risk’. The important role community pharmacy has to play in the delivery of diabetes related health care including screening is then highlighted (section 1.9) Finally, the overall aims of the project of work are specified and the organisation of the thesis and the scope of the data included are outlined in Section 1.11.

1.2 An introduction to diabetes

Diabetes refers to a number of disorders with a number of common features, the most significant of which is raised blood glucose levels. Diabetes can be divided further into a number of different sub-types, the most common of which are: Type 1 diabetes, Type 2 diabetes (T2DM), gestational diabetes and secondary diabetes as a result of pancreatic damage, hepatic cirrhosis, endocrinological disease/therapy, or long term adherence to certain medications.

Type 1 diabetes results from auto immune destruction of pancreatic beta cells resulting in reduced insulin production. This reduction in insulin production impairs the body’s ability to self-regulate levels of glucose in the blood and
urine. Blood glucose levels are raised leading to vascular damage and eventually death due to ketoacidosis if left untreated. Although Type 1 diabetes can occur at any age, it is most commonly diagnosed in children, adolescents and young adults.

T2DM is caused by an insulin resistance or insulin deficiency leading to high blood glucose levels which can cause a number of microvascular and macrovascular complications. It is estimated that approximately 90% of all cases of diabetes worldwide are attributable to T2DM with the remaining 10% compromising Type 1 diabetes, gestational diabetes and other less prevalent subsets of the condition.

1.3 Trends in international, regional and national prevalence of Type 2 Diabetes

Worldwide, it is estimated that diabetes affects 371 million people, which equates to 8.3% of the world’s population. The prevalence of diabetes has been rising at a global level for a number of years; data from a recent meta-analysis shows a 0.07mmol/l and 0.09 mmol/l per decade rise in fasting plasma glucose (FPG) levels for male and female participants respectively. There was a subsequent rise in diabetes prevalence from 153 million in 1980 to 347 million in 2008. Worryingly the incidence rate of diabetes has increased dramatically in the last decade leading to a doubling in prevalence within a generation. In recent years this increasing incidence rate has led to T2DM being referred to as an ‘epidemic’.

The most recent data from the United Kingdom (UK) shows that diagnosed diabetes is prevalent in 6.2% of people aged 17 and over. Trends in diabetes prevalence in the UK have been reflective of those worldwide and have increased dramatically in recent years. In 2004 diabetes affected 1.8 million people aged 17 and over in the UK compared to the latest data from 2012 which suggested that prevalence has increased to over 2.6 million.

Locally in Leicester, the prevalence of diagnosed diabetes is 7.0%. In combination with the estimated undiagnosed prevalence rate of 3.1%, diabetes
is thought to affect 10.1% of the city’s population over 17 years of age\textsuperscript{6}. The prevalence of diabetes within Leicester city is significantly higher than the UK national average\textsuperscript{7}.

It is estimated that 90% of cases of T2DM are preventable\textsuperscript{8}. There are a number of lifestyle based interventions that have been rigorously evaluated in both a research and ‘real world’ setting and found to be effective in reducing overall T2DM risk\textsuperscript{9,10}. The level of success of lifestyle intervention programmes is largely dependent on the availability of screening methods which can identify individuals who would derive the greatest benefit from lifestyle intervention\textsuperscript{11}.

1.4 The financial burden of diabetes

Conservative estimates suggest that diabetes accounts for a total worldwide healthcare expenditure of 465 billion dollars\textsuperscript{2}, increasing to 561 billion dollars by 2030\textsuperscript{12}. In the UK, total spending on diabetes is estimated to be approximately £23 billion, approximately £22 billion of which is attributable to T2DM\textsuperscript{13}. This includes healthcare spending on diabetes but also indirect social and productivity costs. Diabetes healthcare expenditure in isolation in the UK amounts to £8.8 billion\textsuperscript{13}, accounting for 10% of the annual healthcare budget\textsuperscript{14}. The expected increase in T2DM prevalence could potentially raise health expenditure to around £20 billion or 17% of the annual National Health Service (NHS) budget in the near future. It is also estimated that 80% of the treatment costs involved are spent on preventable complications\textsuperscript{15}.

These figures highlight the scope of the problem facing the NHS in dealing with the rising prevalence of T2DM and highlight the need for investment in the prevention of T2DM and its complications\textsuperscript{16}.

1.5 Prevalence of type 2 diabetes related morbidity and mortality

Prolonged periods of high blood glucose levels lead to a number of significant changes at a cellular level which damage the structure of the cell walls causing
vascular damage. The complications caused by prolonged periods of high blood glucose levels can be grouped into microvascular and macrovascular complications. Microvascular complications include damage caused to parts of the body densely populated with small blood vessels such as the eyes, kidneys and extremities. If damage to these small blood vessels is severe, patients may suffer from conditions such as blindness and kidney disease and may require amputation of extremities such as the toes. Macrovascular complications include damage to larger blood vessels such as those in the heart and brain leading to events such as myocardial infarction (MI) and stroke, resulting in an increased risk of mortality.

Past studies have shown a clear association between glycaemic control and risk of mortality. It is well established that 30% of people with T2DM are diagnosed with kidney disease during their lifetime and 60% of people with T2DM will have some form of retinopathy within 20 years of being diagnosed. Rate of leg amputation for people with diabetes is more than 15 times higher than people who do not have diabetes. Individuals with diabetes are also at increased risk of depression, neuropathy and sexual dysfunction compared to individuals without diabetes. As a result of this increased incidence of morbidity, people with T2DM have a life expectancy between 5 and 10 years lower and score significantly lower on commonly used validated measures of quality of life.

1.6 Screening for type 2 diabetes

Screening from a healthcare perspective, is defined as ‘a process of identifying apparently healthy people who may be at increased risk of a disease or condition. They can then be offered information, further tests and appropriate treatment to reduce their risk and/or any complications arising from the disease or condition’.

The World Health Organisation (WHO) commissioned a report detailing criteria to establish which medical conditions justify screening programmes (Figure 1). These criteria were published over 4 decades ago and have since been
updated and made more relevant, with a more extensive set of guidelines published in the UK by the National Screening Committee (NSC) in 2003 \(^{25}\) (Figure 2).

Figure 1. World Health Organisation criteria for screening \(^{24}\)

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>The condition should be an important health problem.</td>
</tr>
<tr>
<td>2.</td>
<td>There should be a treatment for the condition.</td>
</tr>
<tr>
<td>3.</td>
<td>Facilities for diagnosis and treatment should be available.</td>
</tr>
<tr>
<td>4.</td>
<td>There should be a latent stage of the disease.</td>
</tr>
<tr>
<td>5.</td>
<td>There should be a test or examination for the condition.</td>
</tr>
<tr>
<td>6.</td>
<td>The test should be acceptable to the population.</td>
</tr>
<tr>
<td>7.</td>
<td>The natural history of the disease should be adequately understood.</td>
</tr>
<tr>
<td>8.</td>
<td>There should be an agreed policy on whom to treat.</td>
</tr>
<tr>
<td>9.</td>
<td>The total cost of finding a case should be economically balanced in relation to medical expenditure as a whole.</td>
</tr>
<tr>
<td>10.</td>
<td>Case-finding should be a continuous process, not just a &quot;once and for all&quot; project</td>
</tr>
</tbody>
</table>
The more recent UK NSC publication summarised in Figure 2 groups screening criteria together into 4 main categories: the condition, the test, the treatment and the screening programme. The following sections provide discussion and evidence of how the criteria relate to screening for T2DM, and in particular, recent developments and areas of weakness in current screening provision.
1.6.1 Type 2 diabetes and impaired glucose regulation - ‘The condition’

As described in depth earlier in this chapter, the increasing prevalence of T2DM and its complications has resulted in a substantial increase in associated treatment costs. T2DM at the very least can be considered a significant healthcare challenge from a financial perspective. T2DM can be considered an important health problem to both patients and health care providers and matches this aspect of both the WHO and NSC screening criteria\textsuperscript{26}.

Glycaemic control can be seen as a continuum rather than being viewed as a dichotomous scale\textsuperscript{27}, in the majority of cases of T2DM, pancreatic beta cell function deteriorates over as long as 12 years before a diagnosis of T2DM. A state of impaired glucose regulation (IGR) exists when blood glucose levels are raised but not to levels which would satisfy the diagnostic criteria for T2DM\textsuperscript{1}. This hyperglycaemic state has previously been referred to as ‘pre-diabetes’ however this terminology is now considered out of date. ‘Pre-diabetes’ may imply that progression to T2DM within a person’s lifetime is inevitable. The identification of other modifiable risk factors such as sedentary behaviour\textsuperscript{28} as well as improvement in interventions and therapies to treat risk factors has resulted in reductions in rates of progression from IGR to T2DM. Nevertheless, T2DM clearly fulfils criteria for screening in that there is a clearly identified latent disease state during which symptoms or complications may not be present, and the condition clearly represents a significant health burden.

1.6.2 Type 2 diabetes and impaired glucose regulation - ‘The test’

Guidance for the diagnosis of IGR and T2DM has changed in recent years. Prior to 2011, the gold standard diagnostic test for T2DM was the Oral Glucose Tolerance Test (OGTT). Patients attend either their local general practice or hospital having fasted overnight, a baseline blood sample is taken and blood glucose level is assessed. Patients must then consume 75g of glucose, usually in the form of a sports drink within a 5 minute time frame. A second blood sample is taken after 120 minutes and blood glucose level is re-assessed. Despite being considered the gold standard test for diagnoses of T2DM, OGTT
tests are inconvenient for patients. They require patients to attend their practice or hospital for over 2 hours and require the patient to fast overnight.

In 2011 the WHO recommended that glycated hemoglobin (HbA1c/A1c) can be used as an alternative to OGTT testing to diagnose non-pregnant adults\textsuperscript{29}. HbA1c was first identified over 40 years ago as an unusual hemoglobin in patients with diabetes. A correlation with blood glucose measurements has been well established by previous literature, most notably the ADAG study\textsuperscript{30}. HbA1c was introduced into clinical use in 1980 and is now widely used in the diagnosis and monitoring of glycemic control in patients with T2DM. HbA1c level is indicative of average blood glucose concentration over the previous 8-12 weeks\textsuperscript{31}. This test can therefore be performed at any point during the day and the person undergoing the test is not required to be in a fasting state. As a result, HbA1c is the preferred method of assessing levels of glycemic control for patients diagnosed with T2DM. Due to the benefits to the patient of using HbA1c instead of fasting blood glucose there has been increased interest in using HbA1c as a diagnostic test for T2DM but also as a screening tool to detect people at high risk of developing T2DM\textsuperscript{29}, especially when conducting screening using an opportunistic invite.

In addition to the two recommended diagnostic tests, there are a number of tests which are used to screen for T2DM in routine practice. FPG tests are still used by many as a first stage blood test if a person is thought to have a high risk of T2DM based on other risk factors. FPG testing is similar to the initial test during an OGTT, patients attend their practice having fasted overnight, a venous blood sample is taken and analysed for glucose levels. Cut-off points for a high test result are the same as those shown in Figure 3 for the baseline test during an OGTT.
Impaired glucose regulation (IGR) | Type 2 Diabetes (T2DM)
---|---
Diagnoses based on 2011 WHO criteria \(^{32}\) | HbA1c
1 x HbA1c result 6-6.4% (42-47mmol/mol)

OGTT
1 x OGTT result
Pre ≥6.1mmol/l
2hr 7.8-11.1mmol/l

FPG
1 x FPG result 6.1 - 6.9mmol/l | HbA1c
With symptoms: 1 x HbA1c result ≥6.5% (≥48mmol/mol)
With no symptoms: 2 x HbA1c results of ≥6.5% (≥48mmol/mol)

OGTT
With symptoms: 1 x OGTT result
Pre ≥7mmol/l
2hr ≥11.1
With no symptoms: 2 x OGTT results Pre ≥7mmol/l
2hr ≥11.1

With symptoms: 1 x FPG result >7mmol/l
With no symptoms: 2x FPG result >7mmol/l

Random blood glucose (RBG) testing is used less frequently in routine care due to the fact that patients are not required to fast before the test and results vary depending on the quantity and type of food the patient has eaten. This test is more frequently associated with use by other healthcare professionals (HCPs) such as pharmacists who may perform more off-site opportunistic screening. This test can be used as a first stage test to screen for T2DM and IGR, particularly in an opportunistic manner as participants are not required to fast prior to the test. It is important however, that only the two gold standard tests should be used for a diagnosis of T2DM following an abnormal screening result. Current diagnostic cut-off points for T2DM and IGR are summarised in Figure 3.
**Diabetes risk scores**

The different blood tests which can be both the screening and diagnosis of T2DM and IGR have been described in detail earlier in Section 1.6.2. As previously mentioned, these tests are accurate and generally well received by patients. However, one key criteria referenced by both the WHO commissioned report and UK NSC criteria is that screening programmes must be cost effective. The cost of the blood test itself makes up a significant proportion of the cost of the screening. As a result population level screening using a blood test alone is expensive and prohibitive. In order to reduce the cost of screening and better target the use of blood testing, methods of stratifying the population based on an estimate of risk of T2DM taking into account known risk factors have been developed. This sequential method of organising screening ensures that blood tests are only offered to those at high risk which reduces the number of blood tests needed and reduces the overall cost.

The most popular and well used method of estimating T2DM risk is by using a diabetes risk score. Diabetes risk scores have become increasingly popular in recent years and the number of different risk scores that have been developed and are used in primary care reflects this. Part of the reason for the number of different scores is that they tend to perform well in terms of sensitivity and specificity in the populations in which they have been developed, and relatively poorer in other populations. This is possibly due to distribution of risk factors amongst particular populations, for example it is well established that south Asians (SA) have a risk of T2DM which is 3-4 times higher than that of White Europeans (WEs). Because of this, ethnicity may show greater predictive value than smoking status or Body Mass Index (BMI) for example, in a population compromising both SAs and WEs. Due to the heterogeneous distribution of risk factors both between and within populations from individual countries, it is important that risk scores that are used in routine clinical practice are developed and validated in populations with which they are being used in.

Since the 1970’s, Leicester has seen a large number of immigrants originating from the Indian subcontinent, many via East Africa. Data from the 2011 census showed that approximately 36% of the population in Leicester was made up of
SAs compared to 3% UK wide\textsuperscript{36}. In response to the unique make-up of the population in relation to ethnicity, the Leicester self-assessment (LSA) risk score for use in a multiethnic population in Leicester has been developed and validated. This risk score performs very well in the local population compared to other risk scores\textsuperscript{37}.

\textit{The psychological impact of screening for type 2 diabetes}

A key consideration which is made explicit in the more recent NSC criteria is that the benefits of a screening test must outweigh the risks, both in terms of the potential for physical harm from the test itself, and psychological impact that may result from a positive diagnosis. Patient acceptability of T2DM screening tests is generally high with the most frequently cited barrier to screening being time taken to attend the surgery for the test \textsuperscript{38}, in particular the OGTT which requires patients to attend their surgery for over two hours.

A small number of studies have assessed the psychological effect of a positive diagnosis of T2DM upon the patient. As has been discussed previously, asymptomatic individuals who are diagnosed with T2DM would have likely undergone at least two different tests, potentially up to three months apart. There is the potential for a prolonged period of uncertainty from abnormal screening results which could cause anxiety to the patient throughout this process\textsuperscript{39}. In spite of this, the consensus from the literature assessing psychological impact is that there is no significant impact upon individuals diagnosed with T2DM during a targeted screening programme when compared to individuals diagnosed as part of ‘normal care’ \textsuperscript{40,41}.

The potentially harmful effect of ‘labelling’ individuals with a negative test result must also be considered. This is particularly relevant when using any risk score to pre-screen individuals prior to using a blood test. Risk scores have lower levels of accuracy in identifying those at risk when compared to blood tests. As risk score results are based on a composite ‘score’ their use in large scale population level screening may result in a significant number of participants with modifiable risk factors for T2DM such as smoking status and waist
circumference being considered as low risk due to having no non-modifiable risk factors including age, ethnicity and family history of diabetes. A ‘low risk’ result could give reassurance to people who could be at a ‘raised’ risk of T2DM but not sufficiently high to trigger a confirmatory blood test. Despite the potential for reassurance for individuals with a false negative screening test result, literature has found no significant effect on measures of perceived risk of T2DM, intentions to change health related behavior or health.

1.6.3 Type 2 diabetes and impaired glucose regulation - ‘The treatment’

Treatment for patients diagnosed with T2DM has advanced significantly in recent years. Pharmacological treatment has been available for people with T2DM for over 50 years and the effectiveness of new advanced therapies has increased significantly leading to an overall decrease in mortality amongst patients with T2DM. There have also been a number of lifestyle interventions that have proved effective in improving glycaemic control. In addition to drug treatments for T2DM there is emerging evidence for the use of lifestyle intervention (diet and physical activity) to ‘treat’ individuals at high risk of T2DM. Simple walking interventions for example have proved to be effective in reducing measures of glycaemic control in individuals with impaired glucose tolerance (IGT).

In summary, there is strong evidence for the use of a range of pharmacological therapies which have been proved to be effective through pragmatic randomised controlled trials (RCTs), in improving outcomes for patients with T2DM and even delaying or preventing the onset of T2DM in those identified as having a high risk.

1.6.4 Type 2 diabetes and impaired glucose regulation - ‘The screening programme’

The UK NSC screening publication builds upon the previous WHO criteria in considering a screening programme as a whole, rather than a one off test, taking into account who to screen, how to screen and how to treat individuals.
who screen positive. The way in which current evidence relating to T2DM meets these three criteria has been discussed earlier in this chapter.

When evaluating the screening process as a whole, NSC screening criteria also specifies that for a case for screening to be considered, screening and intervention must reduce mortality and morbidity in those who are diagnosed and offered treatment. In addition, the screening methods used must also be quality assured and cost effective.

There is strong RCT evidence from trials which report benefits on mortality in patients with established T2DM through lifestyle modification and pharmacological intervention. The evidence is less clear however, on the effect of screening on mortality and morbidity for patients with screen-detected T2DM. The small number of studies which have assessed the effect of screening for T2DM have found a small but beneficial effect of multifactorial intervention upon mortality.

Recent RCT evidence suggests that there is limited beneficial effect of GP based screening for IGR, followed by early intervention compared to GP practices who do not implement systematic screening. This study concluded that any beneficial effect of screening upon mortality may be smaller than anticipated, or restricted to individuals with T2DM. Despite this, Chatterjee et al reported that screening for IGR in addition to T2DM appeared to be cost-saving compared to no screening from a health system perspective, and potentially cost-neutral from a societal perspective.

At present there is conflicting evidence as to whether targeted population level screening (for example initiating screening for people aged 35-75) is cost effective in the long term. Currently, National Institute for Health and Care Excellence (NICE) guidance recommends screening all individuals with a first stage risk score and offering blood tests to those at moderate and high risk. More recent advances in research have provided such tools as a means of identifying those at high risk, through non-invasive risk assessment methods.

There is a large body of evidence that screening for T2DM is cost effective in the long term due to the improvements in outcomes facilitated by improving
glycemic control. A recent systematic review found that current American Diabetes Association (ADA) recommended interventions for preventing or treating T2DM were cost saving, very cost effective or cost effective compared to no screening and intervention$^{51}$.

1.7 Current position on screening for type 2 diabetes and impaired glucose regulation in the UK

In response to the increase in prevalence of T2DM and cardiovascular disease (CVD), there have been increased efforts by the NSC in the UK through the introduction of the NHS ‘Health Checks’ programme. This was introduced in 2006 to screen all individuals aged 40-75 for risk of T2DM, CVD, stroke and kidney disease, with the majority of this screening carried out by general practitioners (GPs) and practice nurses. One modelling study has anticipated that in a typical practice with a list size of 5600 people this has resulted in an extra 330 appointments per year in addition to the extra follow up appointments required by those at high risk needing further tests or follow up. The latest data shows that locally approximately 30% of those eligible for a vascular check have partaken in one with their GP$^{52}$. Although this figure compares well with data from other regions in the UK it still highlights the majority of eligible people who have not been offered a health check to date.

Figure 4 shows the current recommended screening algorithm from NICE showing the way in which screening tests and diagnostic tests can be utilised, preceded by a simple risk assessment to minimise the number of blood tests needed to identify those with undiagnosed T2DM.
Figure 4. National Institute for Health and Care Excellence type 2 diabetes screening algorithm

Stage one

High risk score

Offer a blood test
Choose either FPG or HbA1c — use as appropriate and according to national quality specifications

Low or intermediate risk score

Offer brief advice on:
- the risks of developing diabetes
- the benefits of a healthy lifestyle
- modifying risk factors

Reassess risk at least every 5 years

Stage two

Moderate risk

FPG < 5.3 mmol/l or HbA1c < 42 mmol/mol (6.0%) Offer a brief intervention to:
- discuss the risks of developing diabetes
- help modify individual risk factors
- offer tailored support services

Reassess risk at least every 5 years

High risk

FPG 5.3–6.9 mmol/l or HbA1c 42–47 mmol/mol (6.0–6.4%) Offer an intensive lifestyle change programme to:
- increase physical activity
- achieve and maintain weight loss
- increase dietary fibre, reduce fat intake, particularly saturated fat

Reassess weight and BMI and offer a blood test at least once a year

Possible type 2 diabetes

FPG ≥ 7.0 mmol/l or HbA1c ≥ 48 mmol/mol (6.5%) Carry out a further blood test if asymptomatic, according to national quality specifications, to confirm or reject the presence of diabetes

Diabetes Enter diabetes management pathway

Figure legend:
FPG = fasting plasma glucose; HbA1c = glycated haemoglobin

Consider a blood test for South Asian and Chinese people aged 25 and over with BMI > 23 kg/m²
1.8 Psychosocial factors which relate to screening uptake and attendance

Development in diagnostic technology has increased the availability of new and easy-to-use screening and diagnostic tests for IGR and T2DM. The accuracy of these tests has been confirmed through extensive validation using large cohorts. Despite this, the limitations of screening initiatives are evident in the fact that it is estimated that up to 500,000 in the UK are living with undiagnosed T2DM\textsuperscript{15}. A high level of patient acceptance of the screening methods used is key to the success of population level screening for T2DM. The success of a screening intervention rests with a patient’s willingness to accept a screening invitation from a health care professional or engage with primary care to organise a screening test. This ‘willingness’ based on an ‘informed choice’\textsuperscript{53} is underpinned by interplay between a number of social, economic and psychological factors.

When considering a specific disease area, the interplay between determinants of health screening behaviour and how each factor impacts on screening attendance can be illustrated by a number of social cognition models. The most frequently cited models which relate to screening uptake are the Health belief model\textsuperscript{54 55 56} shown in Figure 5 and the Theory of planned behaviour model\textsuperscript{57} shown in Figure 6. Both models are used to illustrate how different factors can relate to health behaviour.

The health belief model has been widely used in past literature to explain differences in attendance rates to practice based health screening\textsuperscript{58}. The theory of planned behaviour model has been applied to a variety of contexts including immunisation attendance, drug adherence and screening attendance. Key components of this model include perceived disease susceptibility, perceived severity and the costs and benefits of preventative behaviour. The theory of planned behaviour model\textsuperscript{57} has been applied to both health related and non-health related behaviours. At the centre of this model is an individual’s intention to perform a particular behaviour. Influences on intention to perform behaviour include attitudes towards that behaviour, subjective norms and perceived behavioural control. The main differences between the two models...
are that intentions and social norms are not included in the health belief model and the theory of planned behaviour does not include any measure of perceived disease threat.

In terms of performance of either model in explaining differences in either screening intentions or uptake of screening, there is no literature which focusses on either models predictive accuracy of screening intention or behaviour for T2DM. There has been criticism of the Health Belief Models’ ability to predict health screening behaviour generally. It is suggested that the theory of planned behaviour model may more accurately predict measures of intention to undergo screening for cervical smear testing. However, neither model accurately predicted subsequent screening attendance three months later.
Figure 5. Health Belief Model
Given that existing social cognition models fail to explain all of the variance in screening attendance it is important to look at other factors, for example social and economic factors which may also play a role in screening attendance. The majority of this evidence has found lower rates of participation in screening from individuals from the most socially deprived groups. Interestingly, there does seem to be a small number of studies providing conflicting evidence relating to the role of socio-economic status in the prediction of screening attendance. A recent European retrospective evaluation of a T2DM screening programme found that screening attendees were more likely to be unemployed than people who did not take up a screening invitation. However, a more recent UK based screening intervention aimed at assessing the effects of a screening invitation promoting informed choice found that attendance was lower amongst more deprived groups. It is widely accepted that employment status alone may not be the most accurate measure of social deprivation which would explain the difference in findings in the previously mentioned studies. Other measures of socio-economic status should also be considered, such as the National Statistics Socio-economic Classification (NS-SEC) coding tool or Index of multiple Deprivation (IMD) score. Higher levels of deprivation in screening non-attenders compared to attenders have been reported when using these methods of classifying socio-economic status.
There are also some other demographic factors that are reported to influence screening uptake which have been studied in relation to screening interventions for T2DM. Previous screening studies have shown that being male, having a higher BMI and younger age, are all associated with lower uptake to T2DM screening.

In addition to the way in which people are invited to attend health screening, the methods used in communicating screening results are important in promoting correct interpretation of the results. This may in turn allow patients to make a more informed choice regarding how to act upon these results. Levels of patient understanding of the effect of using different methods of risk communication to communicate health screening results is still relatively low. Previous approaches have centred upon providing ‘average’ risk of contracting a disease. These strategies aim to increase motivation to attend further screening tests that are perceived by healthcare providers or authorities to be in the patient’s best interests.

Alternative approaches to communicating risk favour a more ‘individualised approach’ by providing information that is more relevant to the patient being offered a screening test. This personalisation of the information given is usually based on commonly recognised risk factors such as age or family history. Risk of developing a disease may be presented in the form of ‘absolute risk’, a risk score (a summary of risk scores available for T2DM has been given earlier in this chapter) or categorised into ‘high’, ‘medium’, or ‘low’ risk. This method of personalising risk may be more likely to be relevant for individuals making decisions over screening choices. There is however an acceptance from literature in this area that although decisions regarding screening behaviour may be influenced by the way in which information regarding risk is presented, this cannot be considered as evidence of informed decision making.
1.9 Community pharmacists’ role in healthcare

Globally, demand for healthcare has outstripped supply. This has resulted in an undersupply of HCPs and an expansion of the roles of allied health professionals such as pharmacists who perform duties which were traditionally the preserve of GPs\(^1\). In the majority of countries worldwide community pharmacists are responsible for the supply of prescription medications. In the UK there has been a recent policy shift reflected in guidance from professional pharmacy bodies redefining pharmacists’ role in public health to deliver health advice aimed at preventing disease and monitoring patients with long term conditions\(^2\)\(^-\)\(^4\). The first significant step towards the provision of this enhanced pharmacist role came with the publication of the Nuffield report in 1987 which placed a greater emphasis on the provision of other services by pharmacists\(^5\). A 1987 white paper identified a number of key skills possessed by pharmacists which could be used more effectively in the role of health promotion\(^6\) and in 1992, the Department of Health (DoH) in collaboration with professional pharmaceutical bodies, produced a working party report which re-emphasised the need for development and nurturing of these key skills\(^7\).

Previous research has provided strong evidence showing both; the added value of pharmacists as part of care teams in the management of chronic conditions\(^8\)\(^-\)\(^9\), and the benefits of pharmacist-led educational interventions to reduce risk factors for coronary heart disease (CHD)\(^8\)\(^0\)\(^1\).

Community pharmacies offer a number of other benefits as locations to offer health screening beyond the benefits offered by maximising the skills in health counselling that pharmacists already possess. Pharmacies provide ‘high street’ access to trained HCPs without having to make an appointment to the 90% of the UK population who visit pharmacies annually\(^8\)\(^2\). From a public health perspective, the dialogue between pharmacy staff and customers represents a valuable opportunity to engage with potentially hard to reach groups who may be less likely to access GP based healthcare or be empowered for self-care including the elderly, those from lower socio-economic backgrounds or from minority ethnic groups\(^8\)\(^2\).
Community pharmacists are perceived by patients themselves as trusted professionals with a superior knowledge of over the counter medications who are often the ‘first port of call’ for health care needs\(^\text{71}\). However, patients report lower levels of trust in unfamiliar services delivered by pharmacists when compared to GP led services. Patients still report a preference towards GPs when seeking health advice related to a health condition or service perceived as ‘high risk’. Nevertheless, patient perceptions gathered by previous qualitative studies show that patients do perceive the community pharmacist as a valuable resource in the delivery of health education\(^\text{83}\).

Pharmacists are valuable assets to multidisciplinary teams dealing specifically with people with T2DM\(^\text{84}\). T2DM is an extremely heterogeneous condition; people living with T2DM can suffer varying degrees of a large number of complications such as heart disease, nerve damage, sexual dysfunction and complications during childbirth. As mentioned earlier in this chapter there are an increasing number of treatment options available to both those with newly diagnosed and established T2DM. Treatments can range from dietary and lifestyle advice, to oral glycaemic lowering medication or insulin injections. The high prevalence of complications of T2DM means that people with T2DM can have regular contact with a wide range of HCPs, from diabetes specialist nurses, (DSNs) and GPs to nutritionists and pharmacists through the Medicine Use Review (MUR) service and more recently New Medicine Use reviews (NMR’s). This service involves an ‘adherence centred’ approach with patients on multiple medications for long term conditions such as T2DM and hypertension.

One of the more novel, more recent roles occupied by community pharmacists is in screening and diagnosing medical conditions. Community pharmacists are in a unique position being one of the only examples of HCPs who routinely see people who are ‘apparently well’ in addition to those with diagnosed medical conditions. This is an important point in the context of screening as they share routine face to face contact with members of the public who may not be aware of their own risk of chronic conditions such as T2DM.
Pharmacists also see large numbers of patients who suffer ill health and whom may be less likely to routinely attend their practice, may not be registered at a practice or may not respond to a postal invitation to attend a screening test. Improvements in point of care technology for instant assessment of blood samples to test for lipid profiles or indicators of glycaemic control such as HbA1c or random blood glucose level have resulted in reductions in the cost of these tests and the time taken to produce a result. This has increased the viability of providing these tests as part of population level screening interventions in locations other than GP surgeries and hospitals, such as community pharmacies and community centres.

1.9.1 Pharmacist initiated diabetes screening

A large number of pharmacies in the UK have started to offer screening for a number of risk factors for CVD as well as certain sexually transmitted infections such as chlamydia. These services are predominantly offered on an ad hoc basis, without clear guidance on which patients to screen and what referral cut-off point to use. As a result of this, published robust evaluations of pharmacy led screening are scarce. A recent review noted that studies evaluating the efficacy of pharmacy based screening tools, and in particular studies assessing the cost-effectiveness of screening interventions were lacking. The few studies that have been conducted in the UK suggest pharmacy sites are feasible for identifying a high yield of patients at risk of CVD risk factors including T2DM.

Although screening for T2DM and other CVD risk factors at community pharmacies offers a convenient, easy to access screening test for those to choose to take part there are still a number of potential barriers which must be addressed. Patients with a screening test result which would require follow up would normally have to attend a diagnostic test carried out by a GP or practice nurse. Rate of attrition to this diagnostic test (patients not actually attending the GP for a follow up) is a major barrier to successfully implementing a community pharmacy led screening service for CVD risk factors such as T2DM. Besides the psychological factors already outlined in Section 1.8 that apply to screening
in various contexts, there are a number of organisational factors specific to the community pharmacy setting, which can contribute to increased rate of attrition of screen detected high risk patients who require follow up.

One frequently reported factor important in ensuring that screen detected high risk patients are followed up is the relationship pharmacists share with local GPs. Community pharmacists have previously shown a willingness to prioritise their role in health promotion by providing a service to supplement their primary role distributing prescription medication. However, qualitative studies of GP views have yielded conflicting views on the value of GP-pharmacist collaboration and the extended public health role of the community pharmacist.

For pharmacy based screening to be successful, a collaborative approach between local GPs and community pharmacists is essential to ensure that screen detected ‘high risk’ patients are followed up. Previous studies have found that this is often not the case with less that 50% of participants found to be at high risk of T2DM in the pharmacy receiving a confirmatory blood test at their practice.

Community pharmacists could potentially provide a screening service to patients registered at a number of different GP practices. Hence, collaborative relationships must be built with a number of different practices; this can be difficult due to the low frequency of contact with different practices. Effective collaboration is also very important to ensure there is no duplication of effort in the unnecessary repeat testing of patients by both GPs and pharmacists.

There is some evidence that GPs have shown concern or unease with community pharmacy performing roles previously performed only by GPs themselves. Concerns from GPs focus on a perceived lack of control of a patients’ care, masking of serious conditions, missed diagnosis and the potential for misuse of the medication by the patient. GPs have also questioned whether pharmacists were too influenced by commercial pressures to give unbiased health advice and information. It is difficult to compare levels
of collaboration between GPs and pharmacists between countries as health systems and the way in which primary healthcare is structured between countries differs. Some countries do enjoy a greater degree of collaboration which is facilitated by a shared IT system. Direct access to medical records allows pharmacists to record screening results in patient’s medical notes which removes the need for a referral letter which may not be posted or not correctly entered into medical notes by practice staff. Shared IT systems also allow pharmacists to conduct health screening using an invite system in addition to opportunistic screening. Pharmacists can query medical notes and target interventions for people most likely to be at high risk, a method which is currently being used with some success in primary care based pilot screening studies in the UK 94.

1.10 Chapter summary

In conclusion, T2DM and IGR are clearly well defined conditions which place a significant burden on the patient and the health service as a whole. The potential for pharmacists to occupy an expanding role to assist GPs in identifying both those with undiagnosed T2DM and those at risk of T2DM in the future has been presented in this chapter. Current evidence to support the expanding role of community pharmacists is relatively scarce.

There is a need to review the small number of existing studies in this area to establish the current level of success of previous pharmacy initiated screening programmes for T2DM and CVD risk factors to inform the future design and delivery of screening in community pharmacies. Given the scarcity of studies, and in particularly those with robust methodology, there is also a need to conduct further study in this area to produce more robust data relating to feasibility and acceptability of community pharmacies as sites for screening for T2DM and other CVD risk factors

The following programme of work aims to address these issues arising and provides robust data from a large scale RCT which has been informed by a systematic review and meta-analysis of pertinent literature. In addition the
findings of a qualitative evaluation with pharmacy staff taking part in the main RCT are provided to support the qualitative findings.

1.11 Overview of the programme of work being undertaken

1.11.1 Organisation and scope of the thesis

The remaining chapters of the thesis are summarised in bullet point form below:

- Chapter 2 presents data from a systematic review and meta-analysis which summarised evidence relating to pharmacy based screening for T2DM and CVD risk factors. The results of this systematic review and meta-analysis provide further rationale for the RCT (PRISM study)
- Chapter 3 describes the design and methods used in carrying out the RCT (PRISM study)
- Chapter 4 presents the design, methods and results of the qualitative interview study carried out with pharmacy staff taking part in the RCT. The qualitative results are summarised and discussed in the context of what is already known on the topic. Implications for clinical practice and future research are presented.
- Chapter 5 describes the quantitative findings of the RCT
- Chapter 6 summarises the main findings of the overall programme of work. The implications for clinical practice and future research in the area are discussed.
- Supplementary materials used in carrying out the programme of work, study documentation and copies of publications arising are included in the Appendix.

1.11.2 Scope of the data from the PRISM randomised controlled trial and qualitative evaluation presented in this thesis

The main objective of the programme of work was to evaluate the PRISM study screening interventions which were designed to increase the uptake to confirmatory GP testing in individuals found to be at risk of T2DM. Due to the
time constraints of the PhD studentship recruitment for the main RCT is not yet complete. Data for 1901 participants recruited up to December 2013 are included in the analysis for this programme of work (Chapter 5). Follow up data extracted from participants medical notes held at their general practice collected 1 year after screening is included in Chapter 5. Three, six and twelve month questionnaire data were not available to analyse but will be used to inform a cost effectiveness analysis of the screening methods used and will be completed outside the timescale of the PhD.
Chapter two. The effectiveness of screening for diabetes and cardiovascular disease risk factors in a community pharmacy setting: A systematic review and meta-analysis

2.1 Chapter overview

This chapter reports a systematic review and meta-analysis aimed at synthesising published studies assessing the effectiveness of opportunistic community pharmacy based screening interventions for T2DM and other CVD risk factors. The methods used in searching the literature and analysing data are reported in section 2.4. The descriptive and statistical results of the review and meta-analysis are reported in section 2.5. The results are discussed in the context of other published evidence and the public health implications and implications for researchers and HCPs planning future screening studies are discussed in section 2.6.

2.2 Background and rationale

The worldwide prevalence rates of both CVD and T2DM have seen a gradual rise over recent decades. Chapter 1 provides current data on prevalence rates of both diagnosed and undiagnosed T2DM in addition to providing possible explanations for the recent increase in cases.

As discussed previously, the increased prevalence of T2DM is driving an increasing burden on the NHS budget, predominantly from the inpatient costs of treating CV complications of the disease. This has contributed in part, to the rising cost of treating CVD. The increasing efficacy of drug and lifestyle treatments has led to a fall in the prevalence of CVD related mortality in recent years. Despite this, there has been a continued increase in CV events driven predominantly by a rise in the prevalence of CVD risk factors such as obesity, hypertension and hypercholesterolemia⁹⁵.
This increasing prevalence of T2DM and other CVD risk factors as detailed in Chapter 1 have prompted increased investment in early detection and prevention of lifestyle related diseases such as T2DM and CVD in order to delay or prevent the onset of complications.

Community pharmacists are playing an increasingly prominent role in the delivery of screening services for T2DM and CVD within a pharmacy setting. There have been a small number of studies which have evaluated this method of screening provision. A preliminary literature search revealed that there has not been a systematic review of this literature to summarise the findings of these studies.

The systematic review and meta-analysis presented in this chapter will summarise the findings of published studies to evaluate the level of success of previous pharmacy initiated opportunistic screening interventions for T2DM and CVD risk factors.

Supplementary information, including: the review protocol, data extraction form, search strategy and quality rating criteria used in competing this review and meta-analysis are provided in Appendix one.

2.3 Review aims

- The overall aim of this review was to assess the efficacy of screening interventions using opportunistic methods to screen for T2DM or CVD risk within a community pharmacy setting.

- A secondary aim was to conduct a meta-analysis to establish the proportion of participants who were found to be at risk of either T2DM or CVD who are referred to their GP for follow up tests and the rate at which these participants actually attend this follow up appointment.
2.4 Methods

2.4.1 Data sources and searches

The Cochrane central register of controlled trials, MEDLINE and EMBASE electronic databases were searched from 1950 until April 2012. The search strategy was informed by previous similar systematic reviews\(^6^9\) and comprised of four layers of search terms relating to T2DM, CVD, pharmacy and screening programmes. Keywords and medical subject headings were used to identify papers reporting uptake or yield of screening programmes, with the first phase of screening taking place at pharmacies. No language restrictions were used in the selection of papers. A copy of the search strategy used is included in Appendix one.

2.4.2 Study selection

Studies were reviewed at the title, abstract and full text stage by myself and an independent reviewer (PR), disagreements were resolved through discussion between supervisors, independent reviewer and myself. Authors from the selected full texts were contacted by post and email in an attempt to obtain missing data relating to the main outcomes considered.

2.4.3 Inclusion criteria

Studies were included provided that study participants were recruited in a community pharmacy setting and screened for either T2DM or a CVD risk factor. We defined CVD screening as either: calculation of CVD risk based on a validated scoring algorithm or measurement of blood pressure, lipids or triglyceride levels. T2DM screening was defined as calculation of T2DM risk based on a validated scoring algorithm or assessment of known risk factors or measurement by a pharmacist of blood glucose (either fasting or non-fasting), HbA1c, or any combination of the aforementioned methods. All study designs were considered and studies were not excluded based on publication date or language of publication.
2.4.4 Data extraction and quality assessment

Risk of bias was assessed independently by two reviewers using the US Preventive Services Task Force (USPSTF) Quality Rating Criteria\textsuperscript{96}. These criteria were chosen as they can be used across all study designs. The quality rating criteria used are included in Appendix one. The process involves evaluating each study based on a number of characteristics, including blinding, drop out, measuring procedures used and appropriate statistical analysis techniques and grading as ‘good’, ‘fair’, or ‘poor’. Data extraction was completed independently by two reviewers using a standardised data extraction form, a copy of which is attached in Appendix one.

2.4.5 Data synthesis and analysis

Two main outcomes were assessed, namely i) referral rate to primary care and ii) the uptake to the primary care referral. The referral rate was defined as the number referred divided by the number screened. Uptake was defined as the number attending their GP divided by the number referred.

The log odds of referral were calculated as \( \ln\left(\frac{\text{number referred}}{\text{number screened} - \text{number referred}}\right) \) with standard error \( \sqrt{\left(\frac{1}{\text{number referred}}\right) + \left(\frac{1}{\text{number screened} - \text{number referred}}\right)} \), similar formulae were used for the uptake. Pooled rates were calculated for percentage of the screened population who exceeded cut-off points for hypertension, hypercholesterolemia and T2DM. The log odds were pooled using a random effects model to take into account heterogeneity between studies. Heterogeneity was assessed via the \( I^2 \) statistic\textsuperscript{97}. \( I^2 \) is widely used in meta-analyses to quantify heterogeneity in the data and describes the proportion of the total variance in study estimates that can be attributed to chance.

Estimates were back transformed by taking exponentials and reported as mean referral and uptake rates with 95% confidence intervals (95% CI). All analysis was carried out in Stata (version 12).
2.5 Results

2.5.1 Summary characteristics and quality of included studies

16 individual studies were included in this review\textsuperscript{98-113} (see figure 7). In total, 108,502 participants were screened for CVD risk factors including cholesterol, blood pressure and T2DM. Participants screened had a mean age of 54.6 years and 56.6\% were female. Seven of the studies were conducted in North America, four in the UK, three in Australia, one in Thailand and one in Switzerland. Five studies reported results following T2DM testing or T2DM risk assessment and 15 of the included studies reported results of CVD risk factor screening (see table 1). Nine studies provided data which was included in the meta-analysis\textsuperscript{99,102,105,106,108-112}. All nine provided data on percentage of the screened population referred. One paper published by Krass et al\textsuperscript{102} included two trial arms testing different methods of screening. The two methods had differing rates for referral and uptake of confirmatory testing and were included in the analysis separately. Five studies provided data on uptake of a referral to their GP\textsuperscript{102,105,106,108,110,112}. 
Figure 7. Summary of article selection

MEDLINE: n= 161
EMBASE: n= 129
COCHRANE Libraries: n= 96

Duplicates removed n= 47

Titles and abstracts reviewed n=339

Did not meet inclusion criteria n= 248

Full texts reviewed n=91

Did not report any of the included outcomes=66
Screening was not opportunistic and participants were chosen from practice databases n= 6
Not original research (review article) n= 3

16 studies met all inclusion criteria and were included in the systematic review. 9 provided sufficient data to be included in the meta-analysis
Table 1. Summary of studies included in this review

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<th>Number Screened</th>
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<th>%women</th>
<th>Mean Age (years)(SD)</th>
<th>Total % referred</th>
<th>Uptake</th>
<th>Exceeded Diabetes cut off</th>
<th>Exceeded BP cut-off</th>
<th>Exceeded Cholesterol cut off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donyai</td>
<td>2009</td>
<td>Fair</td>
<td>UK</td>
<td>6287</td>
<td>35.5%</td>
<td>64.5%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Earle</td>
<td>2001</td>
<td>Fair</td>
<td>UK</td>
<td>263</td>
<td>43.7%</td>
<td>56.3%</td>
<td>54.1</td>
<td>16</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Edwards</td>
<td>1981</td>
<td>Poor</td>
<td>UK</td>
<td>215</td>
<td>44.0%</td>
<td>56%</td>
<td>NR</td>
<td>6.1%</td>
<td>NR</td>
<td>6.0%</td>
<td>92.3%</td>
<td>NR</td>
</tr>
<tr>
<td>Hersberger</td>
<td>2006</td>
<td>Good</td>
<td>Switzerland</td>
<td>93,258</td>
<td>33.1%</td>
<td>66.9%</td>
<td>60.9 (14.1)</td>
<td>9.0%</td>
<td>NR</td>
<td>12.8%</td>
<td>6.9% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Horgan</td>
<td>2009</td>
<td>Good</td>
<td>UK</td>
<td>1141</td>
<td>60.0%</td>
<td>40%</td>
<td>NR</td>
<td>70.1%</td>
<td>NR</td>
<td>3.0% NR</td>
<td>14.2%</td>
<td>NR</td>
</tr>
<tr>
<td>Hourihan</td>
<td>2003</td>
<td>Good</td>
<td>Australia</td>
<td>204</td>
<td>29.0%</td>
<td>71%</td>
<td>44 (13)</td>
<td>29.9%</td>
<td>NR</td>
<td>NR</td>
<td>17.7% NR</td>
<td>17.7% NR</td>
</tr>
<tr>
<td>Karwalajtys</td>
<td>2009</td>
<td>Good</td>
<td>Canada</td>
<td>317</td>
<td>40.9%</td>
<td>59.1%</td>
<td>70.9 (10.8)</td>
<td>55.8%</td>
<td>NR</td>
<td>43.9%</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Krass</td>
<td>2007</td>
<td>Poor</td>
<td>Australia</td>
<td>802</td>
<td>26%</td>
<td>74%</td>
<td>NR</td>
<td>28%</td>
<td>NR</td>
<td>56.4%</td>
<td>28.1% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Krass</td>
<td>2007</td>
<td>Poor</td>
<td>Australia</td>
<td>484</td>
<td>36%</td>
<td>64%</td>
<td>NR</td>
<td>24.2%</td>
<td>NR</td>
<td>42.7%</td>
<td>24.4% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Mangum</td>
<td>2003</td>
<td>Good</td>
<td>USA</td>
<td>351</td>
<td>NR</td>
<td>NR</td>
<td>63</td>
<td>34.5%</td>
<td>NR</td>
<td>NR</td>
<td>13.4% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Olenak</td>
<td>2010</td>
<td>Fair</td>
<td>USA</td>
<td>350</td>
<td>NR</td>
<td>NR</td>
<td>48.6 (9.9)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>29.4% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Peterson</td>
<td>2010</td>
<td>Good</td>
<td>Australia</td>
<td>640</td>
<td>28.6%</td>
<td>71.4%</td>
<td>NR</td>
<td>73%</td>
<td>NR</td>
<td>82.7%</td>
<td>5.5% NR</td>
<td>30.0% NR</td>
</tr>
<tr>
<td>Pongwecharak</td>
<td>2010</td>
<td>Good</td>
<td>Thailand</td>
<td>350</td>
<td>NR</td>
<td>NR</td>
<td>48.6 (9.9)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>29.4% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Gardner</td>
<td>1994</td>
<td>Good</td>
<td>USA</td>
<td>97</td>
<td>63.9%</td>
<td>36.1%</td>
<td>48.0 (18)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>17.5% NR</td>
<td>48.4% NR</td>
</tr>
<tr>
<td>Olek</td>
<td>2010</td>
<td>Fair</td>
<td>USA</td>
<td>239</td>
<td>28%</td>
<td>72%</td>
<td>NR</td>
<td>41%</td>
<td>NR</td>
<td>30.5% NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Madjeski</td>
<td>1996</td>
<td>Good</td>
<td>USA</td>
<td>539</td>
<td>35.0%</td>
<td>65%</td>
<td>NR</td>
<td>48%</td>
<td>NR</td>
<td>NR</td>
<td>8.1% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Hutchinson</td>
<td>1979</td>
<td>Fair</td>
<td>USA</td>
<td>926</td>
<td>NR</td>
<td>NR</td>
<td>63</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>8.1% NR</td>
<td>NR</td>
</tr>
<tr>
<td>Mangum</td>
<td>2003</td>
<td>Good</td>
<td>USA</td>
<td>351</td>
<td>NR</td>
<td>NR</td>
<td>63</td>
<td>34.5%</td>
<td>NR</td>
<td>NR</td>
<td>13.4% NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

NR = Not reported

(a) & (b) refers to two study arms from the same two arm randomised study reporting differing rates for the two main included outcomes

Cut-offs Used

**Diabetes** § = tick test scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥5.5mmol/l or random blood glucose ≥4mmol/l; ¶ = tick test scoring method (more than 1 recognised risk factor for diabetes) **Blood Pressure** † = systolic blood pressure ≥160mmHg, ‡ = ≥140mmHg systolic only, †‡ = ≥140/100mmHg †† = random blood glucose ≥10mmol/l, †‡‡ = random blood glucose or ≥11mmol/l fasting blood glucose ≥6mmol/l **Cholesterol** §§ = total cholesterol ≥200mg/dl, §§§ = total cholesterol ≥232mg/dl
2.5.2 Overview of screening interventions

All except two of the studies were of an observational design\textsuperscript{102, 104}; both were trials with some degree of randomisation between screening methods. Five of the studies integrated a sequential screening strategy into the study design with the first stage of the screening process being a non-invasive test. In the majority of cases this was done using a risk score or comparison against pre-selected risk factor cut-off points based on age, ethnicity or BMI. All of the included studies carried out the majority of screening appointments in a pharmacy setting. One study included a small cohort screened during an outreach screening session in a local elderly housing facility\textsuperscript{99}. Of the four studies that provided data, mean consultation time was 10 minutes 30 seconds. Generally, the method in which participants found to be at risk were referred to their clinician was poorly reported. The most common form of referral in studies that did provided data used a print out of their screening results and advised high risk patients to visit their GP. Only four of the included studies provided the clinician with a copy of the results by post or by fax.

2.5.3 Risk of bias assessment

Eleven studies were graded as good\textsuperscript{99, 101, 103-110, 113}, three studies fair\textsuperscript{98, 100, 111} and two studies poor\textsuperscript{102, 112} using the US Preventive Services Task Force (USPSTF) Quality Rating Criteria\textsuperscript{96}. The most common reason for studies being graded as either fair or poor was the quality in describing the screening intervention. Exactly who carried out the consultation in addition to the contact time was particularly poorly reported. The studies graded as poor had a high rate of drop out and high levels of missing data.

2.5.4 Percentage of screening population referred, and uptake of referrals

Significant heterogeneity was found for both main outcomes ($p=<0.001$). Forest plots are presented showing the two main outcomes reported by study, with 95% CI included. Calculated pooled referral/uptake statistics have not been
presented due to the significant between-study heterogeneity found for all outcomes. This is in accordance with previously published guidance\textsuperscript{114}.

Figure 8 displays percentages of the study population referred to their practice from the 9 studies which provided data. There was a strong trend towards higher referral rates in more recent studies. The $I^2$ statistic showed statistically significant heterogeneity for rate of referral with an $I^2$ value greater than 75%. Rates of referral ranged from 9.00\%-72.97\%. Referral criteria for each included study are provided in Table 1. Pooled rates are not provided on each figure due to the heterogeneity.

**Figure 8. Forest plot showing rate of referral for confirmatory testing**
Figure 9 shows percentages of the referred population who attended their practice from the six studies which provided data. The $i^2$ statistic showed statistically significant heterogeneity for rate of uptake with an $i^2$ value greater than 75% in all analyses. Rate of uptake ranged from 12.81% - 92.31% but was typically less than 50%.

**Figure 9. Forest plot showing rate of uptake of referral to a confirmatory test**

<table>
<thead>
<tr>
<th>author</th>
<th>year</th>
<th>N</th>
<th>attended</th>
<th>outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwards</td>
<td>1981</td>
<td>13</td>
<td>12</td>
<td>92.31 (69.94, 98.93)</td>
</tr>
<tr>
<td>Hersberger</td>
<td>2006</td>
<td>8394</td>
<td>1075</td>
<td>12.81 (12.11, 13.54)</td>
</tr>
<tr>
<td>Krass (a)</td>
<td>2007</td>
<td>225</td>
<td>127</td>
<td>56.44 (49.89, 62.78)</td>
</tr>
<tr>
<td>Krass (b)</td>
<td>2007</td>
<td>117</td>
<td>50</td>
<td>42.74 (34.10, 51.84)</td>
</tr>
<tr>
<td>Karwalejty</td>
<td>2009</td>
<td>1312</td>
<td>576</td>
<td>43.90 (41.24, 46.60)</td>
</tr>
<tr>
<td>Peterson</td>
<td>2010</td>
<td>62</td>
<td>43</td>
<td>82.89 (69.98, 90.74)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td>$(i^2\text{-squared}= 99.6%, \ p\leq 0.001)$</td>
</tr>
</tbody>
</table>

Log odds

The percentages of individuals who exceeded diagnostic cut-off points for hypertension, hypercholesterolema and T2DM following a pharmacy based test are shown in Figures 10, 11 and 12 respectively. Diagnostic criteria for each study are provided in Table 1. Rates of referral for hypertension shown in figure 12 showed a trend towards higher rates of referral in more recent studies.
Figure 10. Forest plot showing percentage of individuals exceeding referral cutoff points for type 2 diabetes

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Screened</th>
<th>Cutoff</th>
<th>Percent (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hersberger</td>
<td>2006</td>
<td>93250</td>
<td>6396</td>
<td>6.86 (6.70, 7.02)</td>
</tr>
<tr>
<td>Kraas (a)</td>
<td>2007</td>
<td>802</td>
<td>225</td>
<td>28.05 (25.05, 31.27)</td>
</tr>
<tr>
<td>Kraas (b)</td>
<td>2007</td>
<td>484</td>
<td>118</td>
<td>24.38 (20.76, 28.41)</td>
</tr>
<tr>
<td>Horgan</td>
<td>2009</td>
<td>1141</td>
<td>34</td>
<td>2.98 (2.14, 4.14)</td>
</tr>
<tr>
<td>Peterson</td>
<td>2010</td>
<td>640</td>
<td>35</td>
<td>5.47 (3.95, 7.52)</td>
</tr>
<tr>
<td>Okonak</td>
<td>2010</td>
<td>239</td>
<td>73</td>
<td>30.54 (25.03, 36.67)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td>I² = 99.4%, p &lt; 0.001</td>
</tr>
</tbody>
</table>

Log odds
Figure 11. Forest plot showing percentage of individuals exceeding referral cut-off points for hypercholesterolemia
Figure 12. Forest plot showing percentage of individuals exceeding cut-off points for hypertension

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Screened</th>
<th>Exceeded cut off</th>
<th>Percent (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hutchinson</td>
<td>1979</td>
<td>928</td>
<td>75</td>
<td>8.10 (8.51, 10.04)</td>
</tr>
<tr>
<td>Edwards</td>
<td>1981</td>
<td>215</td>
<td>13</td>
<td>6.05 (3.54, 10.13)</td>
</tr>
<tr>
<td>Gardner</td>
<td>1994</td>
<td>97</td>
<td>17</td>
<td>17.53 (11.18, 26.40)</td>
</tr>
<tr>
<td>Earle</td>
<td>2001</td>
<td>263</td>
<td>123</td>
<td>46.77 (40.81, 52.82)</td>
</tr>
<tr>
<td>Mangum</td>
<td>2003</td>
<td>351</td>
<td>47</td>
<td>13.39 (10.21, 17.37)</td>
</tr>
<tr>
<td>Hounihan</td>
<td>2003</td>
<td>204</td>
<td>36</td>
<td>17.65 (13.01, 23.50)</td>
</tr>
<tr>
<td>Hersberger</td>
<td>2006</td>
<td>93258</td>
<td>13281</td>
<td>14.24 (14.02, 14.47)</td>
</tr>
<tr>
<td>Horgan</td>
<td>2009</td>
<td>1141</td>
<td>370</td>
<td>32.43 (29.77, 35.20)</td>
</tr>
<tr>
<td>Karwiafjys</td>
<td>2009</td>
<td>317</td>
<td>177</td>
<td>55.84 (50.32, 61.21)</td>
</tr>
<tr>
<td>Pongwecharak</td>
<td>2010</td>
<td>350</td>
<td>103</td>
<td>29.43 (24.89, 34.42)</td>
</tr>
<tr>
<td>Peterson</td>
<td>2010</td>
<td>640</td>
<td>192</td>
<td>30.00 (26.57, 33.67)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Referral cut-off point for CVD risk factors varied slightly between studies. A blood pressure cut-off point of ≥140/90mmHg was used by the majority of studies. One study used a cut-off point based on systolic pressure of ≥160mmHg. Four studies referred participants exceeding a cut-off point of 140/90mmHg.

T2DM cut-off points of ≥5.5mmol/L for FBG and ≥11mmol/L for RBG were used by one study. This was in accordance with national guidance from the country in which the study took place. A higher cut-off point of 8mmol/l for FBG was used by Olenak et al as a threshold for referral.
Cholesterol cut-off points used were similar between studies, 3 of the included studies used a cut-off point for total cholesterol of 200mg/dl (5.2mmol/l)\textsuperscript{101,107,103}. Two studies used total cholesterol cut-off points of 232mg/dl(6.0mmol/l)\textsuperscript{105,108}.

### 2.5.5 Prevalence of undiagnosed risk factors for cardiovascular disease

Follow up data from GP confirmatory testing was not routinely reported. Only one study reported data on prevalence of T2DM, IGT or impaired fasting glucose (IFG) defined by WHO diagnostic criteria. Krass et al report 2.1% of the screened population were subsequently diagnosed as having either IGR or IFG based on a fasting or random blood test followed by confirmatory OGTT. The same study reported screen detected prevalence rates of 0.2% and 1.7% from the two trial arms\textsuperscript{102}. A screen detected prevalence of previously undiagnosed raised total cholesterol of 17.28% was reported by one study by Jafari et al\textsuperscript{107}. Only one study reported prevalence of undiagnosed hypertension. A prevalence of 6% was reported by Mangum et al\textsuperscript{99}.

### 2.6 Discussion

#### 2.6.1 Summary of review findings

Overall, the results of this analysis show that typically, less than half of people who take part in studies based on opportunistic recruitment to pharmacy screening for CVD risk factors are referred to their practice for a follow up appointment. A significant proportion of the participants who are referred for a confirmatory test are not followed up, or do not attend their practice.

There was evidence of a strong trend towards higher rates of referral in more recently published studies. There was a very high level of heterogeneity for both of these outcomes with values for referral rate ranging from 6.05%-73.13% and values for percentage take up of this referral ranging from 12.81-83.12%.
This heterogeneity could have been caused by a number of factors including differences in underlying prevalence rates and varying level of screening uptake. It is likely that different methods of measurement of uptake to referral could also have accounted for a significant proportion of the variability. Methods of measurement varied from direct query of medical notes to questionnaires being sent to a small sample of participants who had been referred to their practice for follow up.

From a health economics perspective higher drop-out rates could increase the cost per case detected from screening interventions\(^\text{118}\). By reducing this drop out a higher screen detected prevalence would be expected, thus reducing the cost per case detected.

The rates reported for the percentage of individuals exceeding diagnostic criteria for hypertension, hypercholesterolemia and/or T2DM from pharmacy based screening interventions are typically higher than rates for overall diagnosed prevalence of these risk factors. Prevalence of CVD risk factors amongst pharmacy customers is likely to be higher than the general population as a majority will be attending to collect medication for a condition. Data from a UK study\(^\text{109}\) included in this analysis showed that baseline values for CVD risk factors such as BMI and blood pressure were all higher in pharmacy attending patients compared to population level data\(^\text{119}\).

It is difficult to compare data on referral and uptake with findings from previous literature. Similar data does exist for screening interventions initiated by GPs. However, practice based screening programmes tend to recruit through postal invitations following routine data searches in contrast to opportunistic recruitment in community pharmacies. Referral methods from pharmacy to general practice are not robust. One previous GP initiated T2DM screening intervention reported uptake to screening invitations of 74%, 94% uptake of a confirmatory testing and 70% of participants completing the screening overall\(^\text{120}\). Referral method and active follow up of high risk participants could contribute to the difference in overall dropout rates observed between pharmacy and practice initiated screening interventions.
Chapter two: Systematic review

The finding that more recent studies reported a higher percentage of referrals following a screening appointment is perhaps not surprising. The rising global prevalence of CVD risk factors such as obesity\textsuperscript{121}, hypertension, hypercholesterolemia \textsuperscript{122} and T2DM \textsuperscript{123} would logically lead to a higher number of individuals from a screening population crossing referral thresholds for blood pressure, cholesterol or blood glucose resulting in a larger number of referrals. Increased focus in recent years on the prevention in addition to treatment of lifestyle related diseases has seen the identification of clearly defined pre-diabetic states known as IGR and IGT. Because of this more participants may be referred with a suspected ‘high risk status’ for either T2DM or CVD.

2.6.2 Strengths and weaknesses

The main strength of this study was the use of robust search strategy, review and meta-analysis methods to provide an assessment of the past level of success of previous pharmacy initiated screening interventions. There are no other similar systematic reviews in this area and this synthesis of the literature has identified a key weakness in past screening interventions which must be given greater consideration in the design of future screening studies.

The main weakness of this review and meta-analysis was due to the heterogeneity in selected outcomes. As a result of this, we were unable to calculate and present summary statistics. Research in the area of community pharmacy is sparse, poorly reported and of relatively poor methodological quality. It is possible that with an increased number of screening interventions in the future which are well evaluated and properly reported; future meta-analysis may have more success in calculating pooled rates which may be of greater use in informing the planning of future interventions.

One other potential weakness in this analysis results from the way in which the outcomes included in the meta-analysis were measured. In general, the included papers were of sound methodological quality, however both of the
main outcomes were themselves not major outcomes in any of the included studies. Subsequently there was variation in the method of measurement used. Preferred method of reporting for this outcome was through direct access to practice based medical records following a pharmacy referral. This method was reported in only two of the included studies.\textsuperscript{102, 106} Four studies measured referral rates via a questionnaire with three of those questionnaires being filled out by the research participants\textsuperscript{98, 101, 105} and one being filled out by GPs to whom the referrals were made. Response rates for these questionnaires varied and were lowest for the GP questionnaires (12.8%) and it is likely that such low response rates would lead to significant selection bias in such studies. It could be hypothesised that referred participants who do not attend a referral may be likely to return a questionnaire; percentage uptake of referrals would therefore be higher amongst a sample of participants that did return follow up questionnaires. As a result it is important to consider that the results gained by such questionnaires only apply to the sub group who returned the questionnaires and not necessarily the total population screened.

Despite the weaknesses of the studies included in this review, the results of this study are of great practical value in two ways. Firstly they highlight a need for improvement in the implementation of opportunistic pharmacy based screening programmes in order to minimise the drop out of ‘high risk’ referred patients. The level of drop out from screening programmes for T2DM and CVD risk factors represents a significant waste of investment. Future screening interventions are required to increase ease of access of screening in order to reduce health inequalities particularly in the area of T2DM and CVD. There is a greater need to ensure that those identified at high risk are followed up appropriately in order to maximise the benefit of screening and early intervention. Complete follow up data from large screening studies is necessary to inform future cost effectiveness analyses. This cost effectiveness data is very important in informing the delivery of future screening strategies for T2DM and CVD.
2.7 Chapter summary

The findings of this review show that previous studies of opportunistic pharmacy based screening interventions have been successful in identifying a significant proportion of the population, both suffering from and at high risk of CVD or T2DM. We have shown that more recent screening strategies have identified a higher number of high risk individuals referred to their practice for follow up. However the review has also shown that a high proportion of those individuals found to be at high risk of CVD or T2DM do not attend a follow up appointment at their practice. It is vital that future screening interventions are designed to minimise this drop out in order to maximise both the financial and health related gains from increased investment and interest in future screening interventions in pharmacies worldwide.

There is a need to conduct larger scale RCTs in the area of pharmacy initiated screening for T2DM and other CVD risk factors. Methodological weaknesses including incomplete collection of follow up data following a confirmatory test must be addressed.
Chapter three: Design and methods used to conduct a randomised controlled trial of two methods of pharmacy initiated screening for type 2 diabetes

3.1 Chapter overview
This chapter describes in detail the methods used to conduct the PRISM study. Section 3.2 specifies the primary and secondary research aims. Section 3.5 describes the methodology used to recruiting participating pharmacies and study participants. Details on the screening tools used are described in 3.6 Section 3.10 describes the statistical techniques used in the trial design and proposed analysis of outcome data.

3.2 Research aims
The primary research aim of this study was to establish levels of uptake to a confirmatory blood test for T2DM following either 1) a high self-completed LSA risk score, or 2) a high self-completed LSA risk score followed by a near patient test (NPT) of HbA1c 6% (42mmol) or above.

The secondary research aim was to establish the number of participants diagnosed by their GP with T2DM or IGR in each of the two trial arms (screening yield).

3.3 Setting
The screening took place in 13 inner city community pharmacies within Leicester city and 3 rural community pharmacies in Lincolnshire. Pharmacies were located on ‘high streets’ and within premises shared with local GP practices.
3.4 Ethical approval

The study received approval from Leicestershire, Northamptonshire and Rutland Research Ethics Committee (REC) and approval from NHS Research and Development review panels responsible for the two sites being used for participant recruitment. A steering committee was established to monitor the trial, meeting on a monthly basis. This trial also received support from the local Clinical Trials Unit (CTU), local diabetes research network (DRN) and Primary Care Research Network (PCRN).

This trial is currently open to recruitment. Recruitment for this trial commenced in March 2011 with a proposed recruitment end date of 31st December 2014. The trial is registered online at www.controlled-trials.com. Registration number: ISRCTN10605140.

3.5 Methods

3.5.1 Trial design

This study was designed as a two arm RCT. No control arm was used as there is currently no consensus or guidance on current or best practice for methods used to screen for T2DM in a community pharmacy setting. The design of each of the two trial arms and flow of participants through the trial is shown in figure 13.
Figure 13. PRISM study trial design
3.5.2 Pharmacy recruitment

Pharmacies that took part in a previous evaluation of CVD screening within Leicester city were sent an invitation letter containing an explanation of the study and a reply slip to return if they were interested in taking part. Pharmacies that had not returned a reply slip were contacted by phone to establish willingness to take part. Once all pharmacies had been contacted, 10 pharmacies were selected based on the highest recruitment from the previous CVD screening study and also geographical location. Geographical location was used in the selection of pharmacies for two reasons. Firstly, to ensure that the study cohort included a mix of participants to reflect the demographic characteristics of the local population. Secondly, to avoid overburdening individual practices with a high number of referrals from local pharmacies, efforts were made not to select two pharmacies within close proximity to one another.

Once 10 pharmacies had been selected, they were contacted to confirm willingness to participate in the study. Pharmacies that were not selected were notified and thanked for their expression of interest. Details were kept on these pharmacies in the event that a participating pharmacy subsequently left the study.

3.5.3 Pharmacist training

Prior to the recruitment of the first patient, all participating pharmacists and pharmacy staff attended a 4 hour mandatory training session with staff from the company who manufacture the HbA1c analyser, myself and a colleague. The pharmacists were given extensive training on correct use of the HbA1c analyser and quality assurance procedures. This training was given by the manufacturers of the HbA1c analysers (Siemens). Pharmacists were also given training on the principles of informed consent and good clinical practice (GCP) and introduced to the study documentation and screening procedures. Detailed instructions and guidance on how to use of the LSA risk score was given in an attempt to standardise the methods of risk communication and advice given to participants found to be at high risk and referred to their GP for follow up. A
study guide was given to all pharmacies as a first point of reference for any study queries together with hard copies and electronic copies of study documentation in the event of a copy not being included in the participant pack. A copy of the study guide which was given to participating pharmacists is included in Appendix two.

During the study recruitment period, pharmacies were provided with monthly audit and feedback data relating to their recruitment performance. This was carried out to motivate pharmacists and notify them of their recruitment performance in relation to their peers. Charts were provided via email to show the performance of their pharmacy compared to the other participating pharmacies. Pharmacy names were removed and information was presented alongside a monthly recruitment target.

3.5.4 Participant selection

Participants were identified by a member of pharmacy staff and invited to take part in the study if: they were aged between 40 and 75 years (aged 35-75 years if they were from a BME group due to the increased risk of T2DM amongst this population), did not already have a diagnosis of diabetes, reported not having had a fasting test for T2DM in the previous 12 months and were able to give written informed consent. Potential participants were not approached for the study if they did not meet all of these inclusion criteria.

3.5.5 Participant recruitment

Recruitment for this trial was opportunistic in nature. Potential participants were asked if they would like information regarding the trial as they attended their pharmacy for any reason, such as picking up a prescription, seeking general advice, purchasing over the counter medication or other products which may not be related to health. Participants who indicated that they were willing to receive such information were given a copy of the participant information sheet. The participant was then offered a screening appointment immediately or
booked in at a mutually convenient time. Participants who attended the appointment were given a verbal explanation of the study and were asked to read a copy of the participant information sheet. Participants then had the opportunity to ask the pharmacist any further questions they had. Once the participant was fully informed and in agreement to taking part, they were asked to sign the consent form. Once this process was complete the participant was randomised to one of two trial arms.

3.5.6 Randomisation

Randomisation was completed according to a computer generated block randomisation allocation developed using Microsoft excel. The randomisation sequence was generated by a statistician within my department (LG). The randomisation schedule was held by an independent member of the department.

Participants were assigned individually in a 1:1 ratio to either the ‘risk score’ or ‘risk score + NPT’ trial arm. Due to the nature of the screening intervention and outcomes, blinding of the participant, pharmacist or study team was not possible. Randomisation was facilitated by the pharmacist once the participant had agreed to take part in the study and had completed a consent form. All study information was contained in sequentially numbered sealed envelopes (1 per participant) which were opened once the consent process was completed with each participant. The envelope contained instructions to randomise the participant to one of the two trial arms.

3.6 Screening tools used

3.6.1 Leicester Self Assessed risk score

The LSA risk score was developed using logistic regression modelling on data from 6186 study participants from a recent multi-ethnic UK screening study. It can be used to predict the risk of current IGR or T2DM in asymptomatic individuals. The user inputs data on age, ethnicity, sex, first degree family history of diabetes, history of hypertension or use of antihypertensive
medication, waist circumference and BMI to calculate a score from 0-47. The LSA risk score has been validated using data from a further 3171 participants from a separate local screening study giving an area under the receiver operator characteristic curve of 72% (95% CI 69–74%). A cut-off point of ≥16 points was chosen for this study giving a sensitivity of 81% and a specificity of 45%37.

3.6.2 Near-patient HbA1c test

All pharmacy HbA1c assessments were performed using the Siemens DCV vantage 2000 near patient testing analyser. This particular model has been rigorously validated and is one of only two HbA1c analysers shown to meet clinically acceptable levels of precision, accuracy and bias (coefficient of variation <3%)125 and is recommended as suitable to ‘aid diagnoses’ by national screening committees in the UK and US. During the recruitment period, machines were subject to both internal and external quality assurance procedures. Internal quality control (QC) procedures involved weekly testing of samples stored at the pharmacy which had been provided by the manufacturer. Results, together with a pass or fail decision were entered into a weekly log located at the pharmacy. These results were reviewed on a monthly basis by myself and pharmacists were asked to contact the research team in the event of a failed QC result. External quality assurance procedures involved monthly testing of three fresh blood samples provided by a third party. Results were inputted online or by fax to produce reports which were made available online for review by myself on a monthly basis.

LSA risk score and HbA1c cut-off points were modelled using data from a large scale screening study conducted in Leicester124. An LSA risk score of ≥16 combined with a HbA1c result ≥6% (42mmol/mol) yielded the highest level of specificity and sensitivity and was chosen as the cut-off point for referral.
3.7 Screening intervention

3.7.1 Risk score arm

Participants randomised to the LSA risk score arm were asked to fill in a version of the LSA score. Participants with a score ≥16 were counselled on modifiable risk factors where appropriate and referred to their GP practice for appropriate follow up.

3.7.2 Risk score + near patient test arm

Participants randomised to the risk score + NPT arm were asked to fill in a version of the LSA risk score. Participants with a score ≥16 were offered a HbA1c test at the pharmacy. Participants presenting with a HbA1c result of ≥6% (≥42mmol/mol) were counselled on modifiable risk factors where appropriate and referred to their GP practice for appropriate follow up.

3.8 Referral methods

Participants who met the referral criteria were asked to attend their GP for a follow up blood test. All referred participants were given a results letter following the screening appointment. The referral letter contained their screening test results together with clear instructions as to whether they needed to attend their GP for follow up. A letter was also sent to all participants’ GP. This letter contained the participants screening results to advise their GP as to whether the patient should be contacted to arrange an appointment for a follow up blood test. A sample copy of the participant result letter and GP referral letter are included in Appendix two.

3.9 Outcome measures

3.9.1 Primary outcome measure

The primary outcome measure for this study is the ‘rate of uptake to confirmatory testing for those found to be at high risk of T2DM from either trial arm’. Rate of uptake of testing is specifically defined as the percentage of
referred participants from either trial arm who attend a follow up confirmatory test at their GP within 3 months of being screened at a pharmacy. This information was extracted directly from the study participant’s electronic medical notes held at their practice by myself under the supervision of a member of practice staff. A copy of the data collection form used for the data extraction is included in appendix two.

3.9.2 Secondary outcome measures

Secondary outcome measures include: screen detected prevalence of T2DM and IGR from each trial arm. Diagnosis of T2DM was based on current WHO diagnostic criteria using either a HbA1c or OGTT. Diagnostic criteria are summarised in figure 3. Quality of life and illness beliefs were assessed via questionnaire.

Participants were asked to fill out a questionnaire booklet at baseline and three, six and twelve months after their screening appointment. The questionnaire booklet contained EuroQol (EQ-5D), Brief Illness Perception Questionnaire (BIPQ) and two validated short scales which measure self-perceived absolute and relative risk of T2DM. The two measures of self-perceived risk of T2DM consist of a linear scale of 1-100% with a lower score corresponding with a lower self-perceived risk.

EQ-5D questionnaire is widely used to produce a simple descriptive health profile and a single index value for an individual’s health status. It is not disease-specific and can be used for a wide range of health conditions including T2DM. Output from the EQ-5D can be split into two parts. Firstly, for the purposes of this study, the scoring for each item of the questionnaire will be reported in a frequency table reporting the proportion of reported problems for each level for each dimension. The second set of data is from a visual analogue scale (VAS) which assesses how the participant perceives their general health at that specific point in time. The scale is from 0-100 with a lower score corresponding to a lower perception of one’s own health state.
The BIPQ questionnaire is a widely used assessment tool that uses a single-item scale approach to assess a number of beliefs about a specific illness that are thought to relate to coping and help seeking behaviour. The questionnaire consists of 8 items, each scored on a five point scale. The questionnaire is scored by adding up the scores from each item (with two of the items being reversed scored) to produce a score with a lower BIPQ score corresponding to a more threatening perception of an illness.

A sample copy of the questionnaire booklet is included in appendix two.

### 3.9.3 Follow up data collection.

Questionnaire data was collected at baseline and then again at three, six and twelve months post screening. Questionnaires were posted to study participants to be filled out and returned to the study team using a pre-paid envelope.

A summary of all outcomes collected and time points for data collection is provided in figure 14.
Chapter three: Methods

3.10 Statistical analysis

3.10.1 Power calculation

Based on a power of 80% and significance level of 0.05, 2,204 participants were required for initial screening (1,102 in each arm), to detect a 3.4% difference in uptake to a confirmatory testing at the general practice - 11% in the risk score + NPT arm versus 7.6% in the risk score arm. This is based on a 20% non-attendance rate to the GP in the risk score + NPT arm and a non-attendance rate of 30% to the first confirmatory test and 20% to the second confirmatory test in the risk score arm. The estimated attrition rate was informed by previous community screening programmes within Leicester city\(^{124}\). This also assumes an alpha of 5% with 80% power using a two sided analysis.

---

**Figure 14. Summary of outcome data collected**

<table>
<thead>
<tr>
<th>Screening Appointment</th>
<th>Pharmacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic data</td>
<td>Pharmacy</td>
</tr>
<tr>
<td>LSA Risk score result</td>
<td>Pharmacy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Questionnaires</th>
<th>Pharmacy, self completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIPQ*</td>
<td></td>
</tr>
<tr>
<td>EQ-5D*</td>
<td></td>
</tr>
<tr>
<td>Illness perception Questionnaire*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow up GP Data</th>
<th>Medical records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non clinical</td>
<td></td>
</tr>
<tr>
<td>Had appointment/did not attend</td>
<td></td>
</tr>
<tr>
<td>Date of appointment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical</th>
<th>Medical records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting blood glucose</td>
<td></td>
</tr>
<tr>
<td>Fasting plasma glucose</td>
<td></td>
</tr>
<tr>
<td>HbA1c</td>
<td></td>
</tr>
<tr>
<td>Oral glucose tolerance test</td>
<td></td>
</tr>
<tr>
<td>* collected at baseline, 3, 6 and 12 months</td>
<td></td>
</tr>
</tbody>
</table>
3.10.2 Proposed analysis

Summary statistics including: mean, standard deviation (SD), median and interquartile range (IQR) are presented independently for each trial arm. Data on the primary outcome variables are presented separately for participants from each of the two trial arms. Change from baseline to 12 month in quality of life and illness perception related variables are presented for each trial arm independently and presented graphically. Variation in recruitment between sites is presented graphically. Statistical tests including t-test and $\chi^2$ were used to assess differences in baseline characteristics between referred participants who did and did not attend a follow up confirmatory test at their practice. Choice of statistical test was dependent upon the data type (discrete vs continuous) and whether values for continuous variables were normally distributed.

3.11 Chapter summary

There is currently only a limited amount of published evidence evaluating the feasibility of community pharmacies as sites for providing opportunistic screening for T2DM. The evidence that does exist reports largely incomplete data on definitive diabetes status from current gold standard methods of diagnosis made by GP’s or practice nurses. Traditionally, uptake to these confirmatory tests has been poor\textsuperscript{85}. Data generated from this trial evaluates a method of screening that is focussed on clear referral pathways between pharmacy and general practice and effective risk communication between pharmacy staff and screening participants, informed by results generated from recently developed NPT technology for HbA1c.

Unlike the majority of previous studies in this field, the study design we have chosen is a pragmatic multicentre RCT affording more robust results. It is hoped that the results of this trial will provide evidence based strategies for maximising follow up in high risk individuals recruited through opportunistic community pharmacy based screening programmes for T2DM.
Although efforts were made to standardise information given to participants with the LSA risk score being used as a basis for discussions around increased risk of T2DM, it is difficult to ensure that each participant has been provided with an identical screening intervention. Factors such as the experience level of each of the pharmacy staff delivering the screening could impact upon the understanding and subsequent screening behaviour of different participants.

Previous studies have examined different methods of risk communication using decision aids for example\textsuperscript{128}, in order to achieve changes in screening behaviour. This is the first RCT which will evaluate the use of NPT for HbA1c in a community pharmacy setting in order to maximise uptake to confirmatory testing.

Effective screening strategies for T2DM are essential for identifying individuals both with undiagnosed T2DM and those at high risk of developing T2DM in the future. This allows healthcare providers to implement interventions aimed at controlling or reducing their patients T2DM risk to reduce the risk of complications. From a healthcare perspective, this is advantageous in terms of the cost saving associated with treating complications \textsuperscript{48}. 

Chapter four. Results of the PRISM study: a randomised controlled trial comparing two methods of pharmacy initiated screening for type 2 diabetes.

4.1 Chapter overview

This chapter presents the quantitative results from the PRISM RCT. Data on recruitment from pharmacies taking part in the study is presented in section 4.1. Study participant demographic characteristics are presented in section 4.2 and 4.3. Screening test results from the LSA risk score and HbA1c tests are presented in section 4.4.

Follow up data on referred participants is presented in section 4.6. Primary outcome data on attendance rates is presented in sections 4.7 and 4.8. Secondary outcome data on screen detected prevalence of IGR and T2DM is presented in section 4.9. Finally, data from a statistical analysis focussing on factors affecting attendance to follow up testing is presented in section 4.10.
4.2 Pharmacy recruitment

Initially, eleven pharmacies were invited to take part. These were pharmacies that had successfully engaged in previous research and who had recruited the highest number of participants in a recent CVD screening pilot study in the local area\textsuperscript{129}. Ten of these invited pharmacies took part in the study. Six months into the study (November 2011) a further three pharmacies were approached to take part in order to increase the recruitment rate. These pharmacies were recruited by approaching the local pharmacy committee (LPC) representative who provided contact details for potentially interested pharmacies. These pharmacies were then approached and three were selected to take part in the study. The decision as to which of these pharmacies were selected was based on geographical location and distance to pharmacies already taking part in the study.

One year into the study (May 2012), three additional pharmacies were recruited in order to increase recruitment rates further. These three sites were branches of a national chain of pharmacies. As before, recruitment was facilitated through contacting the local pharmacy representative for this area and three potentially interested pharmacies were contacted and selected to take part in the study. This gave a total of 16 participating pharmacies.

Recruitment rate varied between individual pharmacies as shown in Figure 15. The median number of participants recruited by pharmacy was 52 (IQR 35-190).
4.3 Participant recruitment

A total of 1916 participants were recruited to the study between April 2011 and December 2013. Fifteen participants were excluded from the analyses as they did not meet inclusion criteria for the study based on age (n=13) and diabetes status (n=2). This gave a final total of 1901 participants included in these analyses. A summary of the trial flow showing recruitment and drop-out rates is shown in Figure 16.
Figure 16. Trial flow showing recruitment, referral and drop-out rates

- Total Screened n=1916
  - Randomised to study group n=1901
    - Risk score + NPT arm n=964
      - LSA score ≥ 16 n=566
        - Met referral criteria n=184
          - Referred to GP n=184
            - Did not attend n=34
              - Did not follow up n=25
                - Appointment not suitable n=3
                - Not registered with a GP n=6
              - Missing n=25
            - LSA <16 n=390
        - HbA1c <6% / 42mmol/mol n=382
      - Incorrectly not referred n=78
        - Participant refused referral n=18
        - Reason unknown n=26
          - HbA1c <6% / 42mmol/mol n=36
      - LSA <16 n=426
    - Risk score arm n=937
      - LSA score ≥ 16 n=511
        - Met referral criteria n=511
          - Referred to GP n=433
            - Did not attend n=125
              - Did not follow up n=81
                - Appointment not suitable n=21
                - Not registered with a GP n=23
              - Missing n=95
            - Attended First GP appointment n=223
          - Attended second GP appointment n=31
            - Confirmed cases T2DM n=24
              - IGR: n=34
4.4 Baseline characteristics

The baseline characteristics and baseline questionnaire results are presented for the overall study population and by study arm in Table 2. The randomisation procedure led to a similar number of participants in each study arm. Of the 1901 study participants included in the analysis, 733 (39%) were male, 942 (50%) were of WE ethnicity and median age was 52 years (IQR 45-61 years).

Table 2. PRISM study participant demographic characteristics

<table>
<thead>
<tr>
<th></th>
<th>All (n=1901)</th>
<th>Risk Score + NPT arm (n=964)</th>
<th>Risk score arm (n=937)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) (median (IQR))</td>
<td>52 (45-61)</td>
<td>52 (45-61)</td>
<td>52 (45-61)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>733 (38.56)</td>
<td>386 (40.04%)</td>
<td>347 (37.03%)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>1168 (61.44)</td>
<td>1168 (61.44%)</td>
<td>590 (62.97%)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White European (%)</td>
<td>942 (49.55)</td>
<td>471 (48.86)</td>
<td>471 (50.27)</td>
</tr>
<tr>
<td>South Asian (%)</td>
<td>759 (39.93)</td>
<td>383 (39.73)</td>
<td>376 (40.13)</td>
</tr>
<tr>
<td>Other Ethnic Group (%)</td>
<td>200 (10.52)</td>
<td>110 (11.41)</td>
<td>90 (9.61)</td>
</tr>
<tr>
<td>Family history of diabetes (%)</td>
<td>761 (40.03)</td>
<td>408 (42.32)</td>
<td>353 (37.67)</td>
</tr>
<tr>
<td>History of hypertension (%)</td>
<td>480 (25.25)</td>
<td>244 (25.31)</td>
<td>236 (25.19)</td>
</tr>
<tr>
<td>BIPQ score (n=1509) (Mean (SD))</td>
<td>41.60 (6.60)</td>
<td>41.51 (6.62)</td>
<td>41.69 (6.58)</td>
</tr>
<tr>
<td>EQ-5D Mobility (n=1628)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problems (%)</td>
<td>1354 (83.17)</td>
<td>693 (83.49)</td>
<td>661 (82.83)</td>
</tr>
<tr>
<td>Some problems (%)</td>
<td>274 (6.83)</td>
<td>137 (16.51)</td>
<td>137 (17.17)</td>
</tr>
<tr>
<td>Major problems (%)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Self-care (n=1623)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problems (%)</td>
<td>1549 (95.44)</td>
<td>794 (96.01)</td>
<td>755 (94.85)</td>
</tr>
<tr>
<td>Some problems (%)</td>
<td>68 (4.19)</td>
<td>29 (3.51)</td>
<td>39 (4.90)</td>
</tr>
<tr>
<td>Major problems (%)</td>
<td>6 (4.07)</td>
<td>4 (0.48)</td>
<td>2 (0.25)</td>
</tr>
<tr>
<td>Usual Activities (n=1621)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problems (%)</td>
<td>1399 (86.30)</td>
<td>719 (86.94)</td>
<td>680 (85.64)</td>
</tr>
<tr>
<td>Some problems (%)</td>
<td>213 (13.14)</td>
<td>104 (12.58)</td>
<td>109 (13.73)</td>
</tr>
<tr>
<td>Unable to perform usual activities (%)</td>
<td>9 (0.56)</td>
<td>4 (0.48)</td>
<td>5 (0.63)</td>
</tr>
<tr>
<td>Pain/Discomfort (n=1633)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No pain/discomfort (%)</td>
<td>949 (58.11)</td>
<td>482 (57.86)</td>
<td>467 (58.38)</td>
</tr>
<tr>
<td>Moderate pain/discomfort (%)</td>
<td>597 (36.56)</td>
<td>309 (37.09)</td>
<td>288 (36.00)</td>
</tr>
<tr>
<td>Extreme pain/discomfort (%)</td>
<td>87 (5.33)</td>
<td>42 (5.04)</td>
<td>45 (5.63)</td>
</tr>
<tr>
<td>Anxiety/Depression (n=1631)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not anxious/depressed (%)</td>
<td>1226 (75.17)</td>
<td>617 (74.16)</td>
<td>609 (76.22)</td>
</tr>
<tr>
<td>Moderately anxious/depressed (%)</td>
<td>350 (21.46)</td>
<td>186 (22.36)</td>
<td>164 (20.53)</td>
</tr>
<tr>
<td>Extremely anxious/depressed (%)</td>
<td>55 (3.37)</td>
<td>29 (3.49)</td>
<td>26 (3.25)</td>
</tr>
<tr>
<td>Visual Analogue scale (Median (IQR))</td>
<td>75 (60-85)</td>
<td>75 (60-82)</td>
<td>75 (60-90)</td>
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<tr>
<td>Diabetes risk perceptions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Relative' risk question (n=1602)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Much lower (%)</td>
<td>168 (10.49)</td>
<td>85 (10.57)</td>
<td>83 (10.40)</td>
</tr>
<tr>
<td>A little lower (%)</td>
<td>355(22.16)</td>
<td>165 (20.52)</td>
<td>199 (23.81)</td>
</tr>
<tr>
<td>About the same (%)</td>
<td>683 (42.63)</td>
<td>344 (42.79)</td>
<td>339 (42.48)</td>
</tr>
<tr>
<td>A little higher (%)</td>
<td>330 (20.60)</td>
<td>165 (20.52)</td>
<td>165 (20.68)</td>
</tr>
<tr>
<td>Much higher (%)</td>
<td>66 (4.12)</td>
<td>45 (5.60)</td>
<td>21 (2.63)</td>
</tr>
<tr>
<td>'Absolute' risk question (Median (IQR))</td>
<td>50.00 (10-60)</td>
<td>50.00 (10-60)</td>
<td>50.00 (10-60)</td>
</tr>
</tbody>
</table>
4.5 LSA risk score results

LSA risk score data is displayed in Table 3, both separately for each study arm ("risk score + NPT arm" and "risk score arm"), and for the study population as a whole.

Table 3. PRISM study participants’ LSA risk score information

<table>
<thead>
<tr>
<th></th>
<th>All (n=1901)</th>
<th>Risk Score + NPT arm (n=964)</th>
<th>Risk score arm (n=937)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49 years and younger</td>
<td>832 (43.77)</td>
<td>432 (44.81)</td>
<td>400 (42.69)</td>
</tr>
<tr>
<td>50-59 years</td>
<td>566 (29.66)</td>
<td>272 (28.22)</td>
<td>294 (31.38)</td>
</tr>
<tr>
<td>60-69 years</td>
<td>356 (18.33)</td>
<td>181 (18.78)</td>
<td>175 (18.68)</td>
</tr>
<tr>
<td>70 years</td>
<td>146 (7.68)</td>
<td>78 (8.09)</td>
<td>68 (7.26)</td>
</tr>
<tr>
<td>Missing data</td>
<td>1 (0.05)</td>
<td>1 (0.10)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td><strong>Gender (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>733 (38.56)</td>
<td>386 (40.04)</td>
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</tr>
<tr>
<td>Female</td>
<td>1168 (61.44)</td>
<td>578 (59.96)</td>
<td>590 (62.97)</td>
</tr>
<tr>
<td>Missing data</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td><strong>Ethnicity (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White European</td>
<td>942 (49.55)</td>
<td>471 (48.86)</td>
<td>471 (50.27)</td>
</tr>
<tr>
<td>Any Other Ethnic Group</td>
<td>959 (50.45)</td>
<td>493 (51.14)</td>
<td>466 (49.73)</td>
</tr>
<tr>
<td>Missing data</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td><strong>Family history of diabetes (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>761 (40.03)</td>
<td>408 (42.32)</td>
<td>353 (37.67)</td>
</tr>
<tr>
<td>No</td>
<td>1133 (59.40)</td>
<td>553 (57.67)</td>
<td>580 (61.90)</td>
</tr>
<tr>
<td>Missing data</td>
<td>7 (0.37)</td>
<td>6 (0.62)</td>
<td>1 (0.11)</td>
</tr>
<tr>
<td><strong>Waist size group (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 90cm</td>
<td>725 (38.14)</td>
<td>342 (35.48)</td>
<td>383 (40.88)</td>
</tr>
<tr>
<td>90-99cm</td>
<td>576 (30.30)</td>
<td>313 (32.47)</td>
<td>263 (28.07)</td>
</tr>
<tr>
<td>100-109cm</td>
<td>368 (19.36)</td>
<td>191 (19.81)</td>
<td>177 (18.89)</td>
</tr>
<tr>
<td>110cm and above</td>
<td>209 (11.00)</td>
<td>102 (10.58)</td>
<td>107 (11.42)</td>
</tr>
<tr>
<td>Missing data</td>
<td>23 (1.21)</td>
<td>15 (1.56)</td>
<td>7 (0.75)</td>
</tr>
<tr>
<td><strong>BMI group (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 25</td>
<td>629 (33.09)</td>
<td>293 (30.39)</td>
<td>336 (35.86)</td>
</tr>
<tr>
<td>25-29</td>
<td>716 (37.66)</td>
<td>370 (38.38)</td>
<td>346 (36.93)</td>
</tr>
<tr>
<td>30-34</td>
<td>364 (19.15)</td>
<td>194 (20.12)</td>
<td>170 (18.14)</td>
</tr>
<tr>
<td>35 and above</td>
<td>171 (9.00)</td>
<td>91 (9.44)</td>
<td>80 (8.54)</td>
</tr>
<tr>
<td>Missing data</td>
<td>21 (1.10)</td>
<td>16 (1.66)</td>
<td>5 (0.53)</td>
</tr>
<tr>
<td><strong>History of hypertension (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>480 (25.25)</td>
<td>244 (25.31)</td>
<td>236 (25.19)</td>
</tr>
<tr>
<td>No</td>
<td>1412 (74.28)</td>
<td>714 (74.07)</td>
<td>696 (74.89)</td>
</tr>
<tr>
<td>Missing data</td>
<td>9 (0.47)</td>
<td>6 (0.62)</td>
<td>3 (0.32)</td>
</tr>
<tr>
<td><strong>Risk category (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk (0-6 points)</td>
<td>219 (11.52)</td>
<td>114 (11.83)</td>
<td>105 (11.21)</td>
</tr>
<tr>
<td>Medium Risk (7-15 points)</td>
<td>597 (31.40)</td>
<td>276 (28.63)</td>
<td>321 (34.26)</td>
</tr>
<tr>
<td>High Risk (16-24 points)</td>
<td>716 (37.66)</td>
<td>374 (38.00)</td>
<td>342 (36.50)</td>
</tr>
<tr>
<td>Very High Risk (&gt;25)</td>
<td>361 (18.99)</td>
<td>192 (19.92)</td>
<td>169 (18.04)</td>
</tr>
<tr>
<td>Missing data</td>
<td>8 (0.42)</td>
<td>8 (0.83)</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>Risk Score (Median (IQR))</strong></td>
<td>17(11-23)</td>
<td>17(11-23)</td>
<td>16 (11-22)</td>
</tr>
</tbody>
</table>

4.6 Baseline quality of life, illness perceptions and health beliefs

At baseline, complete data was available to allow calculation of Brief Illness Perception Questionnaire (BIPQ) score for 1509 study participants (79.38%). Mean BIPQ score was 41.60 (SD 6.60).

EQ-5D results are shown in table 2. EQ-5D VAS data was available for 1297 participants (68.23%). Median (VAS) score was 75 (IQR 60-85).
T2DM risk perception questionnaire results are shown in Table 2. Data from the question measuring absolute risk was available for 1602 participants (84.27%). Median score was 50% (IQR 10%-60%). Accuracy of participants’ self-perceived T2DM risk was assessed by performing correlation analysis between participants’ LSA risk score and data from the question on self-perceived absolute risk. This correlation was significant (p<0.001) (spearman’s rho = 0.25). Data from these two continuous variables was then split into quartiles (low risk, medium risk, high risk and very high risk). Agreement between the two variables was good with 705 (44.01%) participants correctly estimating their risk quartile.

### 4.7 Rates of referral to general practices

#### 4.7.1 Risk score + NPT arm

566 (58.71%) participants in the ‘risk score’ arm had a risk score of ≥16. 174 (18.05%) participants in the ‘risk score + NPT’ arm had a score of ≥16 and a HbA1c of ≥6% which met the referral criteria. HbA1c result was missing for 10 participants from the NPT arm, however all 10 participants were recorded as being referred to their GP for follow up. This gave a total number of 184 participants referred, equivalent to 19.09% of the 964 participants screened in this study arm.

#### 4.7.2 Risk score arm

511 (54.54%) participants in the ‘risk score’ arm had a risk score of ≥16 which met the referral criteria. 78 participants were not referred to their GP for follow up despite meeting the referral criteria (participants refused referral (n=18), HbA1c given in error and result was <6% (<42mmol/mol) (n=34), reason not known (n=26)). This gave a total number of 433 participants referred to their practice from the risk score arm, equivalent to 46.21% of the 937 participants screened in this study arm. This data is summarised in Table 4.
Table 4. Data for participants meeting the PRISM study referral criteria

<table>
<thead>
<tr>
<th></th>
<th>Risk score arm 5.1 (54.54)</th>
<th>Risk score arm n=937</th>
<th>Risk score + NPT arm n=964</th>
<th>NPT HbA1c Result (%) (median (IQR))</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (n=1901)</td>
<td>1077 (56.65)</td>
<td>566 (58.71)</td>
<td>5/7 (6.5-6.0)</td>
<td>&lt;6.0% (&lt;42mmol/mol) (%)</td>
<td>382 (67.49)</td>
<td>135 (23.85)</td>
<td>39 (6.71)</td>
<td>10 (1.77)</td>
<td>N/A</td>
</tr>
<tr>
<td>≥16 risk score (%)</td>
<td>184 (100.00)</td>
<td>433 (84.74)</td>
<td>18 (2.59)</td>
<td>18 (3.52)</td>
<td>26 (5.09)</td>
<td>34 (6.65)</td>
<td>0 (0.00)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Number Referred (% of those meeting referral criteria)</td>
<td>617 (88.78)</td>
<td>34 (4.89)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant refused referral (%)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not referred (reason unknown) (%)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant had NPT HbA1c of &lt;6% Missing data</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.7.3 Characteristics of participants referred to their GP

For study participants in the 'risk score +NPT' arm, median HbA1c measured at the pharmacy was 5.7% (IQR 5.5-6.0%) (38.8mmol/mol (IQR 36.6-42.1)). Results from the NPT for HbA1c are summarised in table 4.

Median age of study participants who were referred to their GP for follow up was 57 years (IQR 51-65). Participants who were referred were significantly older than participants who were not referred (p=<0.001). Characteristics for referred participants split by study arm and the study population as a whole are summarised in table 5.
### Table 5. Data for PRISM study participants who were referred to their general practice

<table>
<thead>
<tr>
<th></th>
<th>All (n=617)</th>
<th>Risk Score + NPT arm (n=184)</th>
<th>Risk score arm (n=433)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Years) (Median (IQR))</strong></td>
<td>57 (51-65)</td>
<td>58 (51-66)</td>
<td>57 (51-65)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>265(42.95)</td>
<td>79(42.93)</td>
<td>186(42.96)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>352(57.05)</td>
<td>105(57.07)</td>
<td>247(57.04)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White European (%)</td>
<td>257(41.65)</td>
<td>55(28.89)</td>
<td>202(46.65)</td>
</tr>
<tr>
<td>South Asian (%)</td>
<td>288 (46.68)</td>
<td>105(57.07)</td>
<td>183 (42.63)</td>
</tr>
<tr>
<td>Other ethnic group (%)</td>
<td>72 (11.67)</td>
<td>24 (13.04)</td>
<td>48 (11.09)</td>
</tr>
<tr>
<td><strong>Family History of Diabetes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (%)</td>
<td>299(48.46)</td>
<td>90 (48.91)</td>
<td>209(48.27)</td>
</tr>
<tr>
<td>No (%)</td>
<td>318(51.54)</td>
<td>94 (51.09)</td>
<td>224(51.73)</td>
</tr>
<tr>
<td><strong>History of Hypertension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (%)</td>
<td>239(38.74)</td>
<td>72(39.13)</td>
<td>167(38.57)</td>
</tr>
<tr>
<td>No (%)</td>
<td>378(61.26)</td>
<td>112(60.87)</td>
<td>266(61.43)</td>
</tr>
<tr>
<td><strong>Risk score (Median (IQR))</strong></td>
<td>23 (19-27)</td>
<td>24 (20-29)</td>
<td>22 (19-26)</td>
</tr>
</tbody>
</table>
4.8 Attendance at general practice

Follow up data was available for 493 (79.90%) of the 617 participants referred to their GP for follow up from both study arms combined.

For participants with follow up data available, rates of attendance at follow up testing were 76.34% (n=111) for the risk score + NPT arm and 68.30% (n=223) for the risk score arm. This 8.0% difference between rates was non-significant (p=0.091) however, the result suggests a trend towards higher rates of attendance in the risk score + NPT arm.

4.8.1 Risk score + NPT arm

In the risk score + NPT arm, data was available for 145 of the 184 (78.80%) participants referred to their GP surgery for a follow up blood test. 111 participants attended their GP surgery and 34 participants did not (advised by their GP that an appointment was not necessary (n=3), not registered with a GP (n=6) reason not known n= 25))

Because of the pragmatic nature of the study, and the fact that decisions over type of test given at the follow up appointment was made by GPs, the test type or combination of tests varied between practices. Participants had either one, or a combination of an HbA1c test, a FPG and/or an OGTT. As a result, it was possible that a participant could have more than one ‘abnormal result’ at follow up.

Sixty five participants from the risk score + NPT arm (58.56%) had at least one ‘abnormal’ blood result at the first follow up blood test. Of these participants who returned an abnormal blood test result, 65 had a raised HbA1c result (≥6%) (≥42mmol/mol), 9 had a raised FPG result (≥6.1mmol/l) and 4 had a raised OGTT result (pre ≥6.1mmol/l or 2hr≥7.8mmol/l)) result.

Twenty five participants (2.59%) from the risk score + NPT arm attended a second follow up appointment at their GP. As with the first appointment, decisions over type of test given was made by GPs, the test type or combination of tests varied between practices Of the participants with an
abnormal second test result, 16 had a raised HbA1c, 9 had a raised FPG and 2 had a raised OGTT result.

4.8.2 Risk score arm

In the risk score arm, data was available for 348 of the 433 (80.36%) participants referred to their GP surgery for a follow up blood test. 223 participants attended their GP surgery and 125 participants did not (GP advised appointment was unnecessary (n=21), 23 not registered with a GP (n=23) and reason not known (n=81).

In the risk score arm, 58 participants (26.01%) had at least one ‘abnormal’ blood test result at the first follow up appointment. Of the participants with an abnormal test result, 54 had a raised HbA1c, 14 had a raised FPG and 4 had a raised OGTT.

31 participants (3.31%) from the risk score arm attended a second follow up appointment. Of these participants, 22 had a raised HbA1c result, 2 had a raised FPG result and 5 had a raised OGTT result.

Follow up data is summarised for the study population overall and split by study arm in table 7 below. Data on participants who attended a follow up blood test are given as a percentage of participants with follow up data available. Further supplementary data collected from general practices is provided in Appendix two.
Table 6. Summary of follow up data collected from general practices

<table>
<thead>
<tr>
<th>Total (n=1901)</th>
<th>Risk score + NPT Arm (n=964)</th>
<th>Risk score arm (n=937)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred</td>
<td>617</td>
<td>223 (64.08)</td>
</tr>
<tr>
<td>Attended (%)</td>
<td>334 (67.75)</td>
<td>111 (76.55)</td>
</tr>
<tr>
<td>Did not attend (%)</td>
<td>184</td>
<td>159 (32.25)</td>
</tr>
<tr>
<td>Not followed up (%)</td>
<td>159</td>
<td>34 (3.73)</td>
</tr>
<tr>
<td>Appointment deemed 'not suitable' (%)</td>
<td>106 (21.50)</td>
<td>25 (17.24)</td>
</tr>
<tr>
<td>Not registered with a GP (%)</td>
<td>24 (4.87)</td>
<td>9 (1.24)</td>
</tr>
<tr>
<td>Missing Data (%)</td>
<td>124 (20.10)</td>
<td>6 (4.14)</td>
</tr>
<tr>
<td>Attended GP (%)</td>
<td>334 (67.75)</td>
<td>111 (76.55)</td>
</tr>
<tr>
<td>Diabetes status</td>
<td>T2DM (% of total study arm)</td>
<td>50 (2.63)</td>
</tr>
<tr>
<td>IGR (% of total study arm)</td>
<td>71 (3.73)</td>
<td>37 (2.07)</td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>Estimated overall prevalence rate</td>
<td>3.48 (2.70-4.40)</td>
</tr>
<tr>
<td>T2DM (% of total population screened (95% CI))</td>
<td>3.48 (2.70-4.40)</td>
<td>2.35-4.79</td>
</tr>
<tr>
<td>IGR (% of total population screened (95% CI))</td>
<td>4.59 (3.34-6.13)</td>
<td>3.34-6.13</td>
</tr>
</tbody>
</table>
4.9 Prevalence of type 2 diabetes and impaired glucose regulation

Criteria used to define T2DM and IGR are shown in Figure 3. The criteria are based on the 2011 WHO criteria\textsuperscript{32}. The prevalence of T2DM and IGR respectively was 2.7% and 3.84% for the risk score + NPT arm and 2.49% and 3.63% for the risk score only arm. Prevalence of T2DM and IGR for the total study population was 2.63% and 3.73% respectively.

Sensitivity analysis was performed to calculate estimated screen detected prevalence for the study population overall taking into account missing data that has not yet been collected for 124 participants (20.10%). This was performed using rates established from data for participants that had been followed up. Results from the sensitivity analysis yielded an estimated prevalence rate of 3.48% (95%CI 2.70%-4.40%) for T2DM and 4.55% (95%CI 3.63%-5.60%) for IGR for the total study population. Estimated prevalence rates of T2DM and IGR split by study arm were 3.56% and 4.59% for the risk score + NPT arm and 3.40% and 4.54% for the risk score only arm.

4.10 Predictors of uptake of a referral

Characteristics of attending and non-attending participants were compared from both study arms collectively. Comparison between attenders and non-attenders showed that attenders were older (59 IQR 52-66) than non-attenders (55 IQR 49-64) years (p=0.008). All other between group differences in characteristics were non-significant. Results from this comparison between those who did and did not attend their practice are summarised in Table 7.
Table 7. Data showing differences between participants who did, and did not attend a confirmatory test

<table>
<thead>
<tr>
<th></th>
<th>Attended</th>
<th>Did not attend</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>332 (67.27)</td>
<td>161 (32.73)</td>
<td>0.355</td>
</tr>
<tr>
<td>Female (%)</td>
<td>356 (72.26)</td>
<td>137 (27.74)</td>
<td></td>
</tr>
<tr>
<td><strong>Age (years) (median (IQR))</strong></td>
<td>59(52-66)</td>
<td>55(49-64)</td>
<td>0.008*</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White European (%)</td>
<td>340 (68.95)</td>
<td>153 (31.05)</td>
<td>0.436</td>
</tr>
<tr>
<td>Other ethnic group (%)</td>
<td>357 (72.35)</td>
<td>136 (27.65)</td>
<td></td>
</tr>
<tr>
<td><strong>HbA1c result (%) (median (IQR))</strong></td>
<td>6.1(6-6.3)</td>
<td>6.1(6-6.4)</td>
<td>0.299</td>
</tr>
<tr>
<td><strong>Family history of diabetes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (%)</td>
<td>345 (69.95)</td>
<td>148 (30.05)</td>
<td>0.761</td>
</tr>
<tr>
<td>No (%)</td>
<td>353 (71.55)</td>
<td>140 (28.45)</td>
<td></td>
</tr>
<tr>
<td><strong>Risk score (median (IQR))</strong></td>
<td>23 (19-27)</td>
<td>22(19-25)</td>
<td>0.106</td>
</tr>
<tr>
<td><strong>BIPQ Score (mean (SD))</strong></td>
<td>41.74 (6.54)</td>
<td>41.86 (6.63)</td>
<td>0.964</td>
</tr>
<tr>
<td><strong>EQ-5D Visual Analogue Scale (mean (SD))</strong></td>
<td>70.79 (18.21)</td>
<td>71.47 (17.54)</td>
<td>0.962</td>
</tr>
<tr>
<td><strong>Self-perceived relative risk of diabetes scale (mean (SD))</strong></td>
<td>46.77 (22.27)</td>
<td>43.51 (21.27)</td>
<td>0.251</td>
</tr>
</tbody>
</table>

* indicates statistically significant difference
4.11 Chapter summary

This chapter has reported the baseline and follow up results from the initial analysis of PRISM RCT trial data. The following chapter presents data from the qualitative assessment of feasibility and acceptability conducted as part of the wider programme of research.

The quantitative findings described in this chapter are discussed in detail in Chapter six. Recommendations for future research and the clinical implications of the findings of the programme of work as a whole are also presented.
Chapter five. Pharmacists’ views on the feasibility and acceptability of the PRISM study screening methods: Qualitative methods and results.

5.1 Chapter summary

The overall aim of the qualitative study was to gather pharmacists’ views relating to the acceptability and feasibility of the two screening methods, including reflections on communicating test results to participants.

The methods and approach used in collecting and analysing the data is described in detail. The main findings are then presented grouped into three broad themes which emerged during the data collection and analysis process. The first theme was: evaluation of the screening process; this theme included reflections on how pharmacists managed the extra appointments together with their thoughts on the screening equipment and study procedures. The second theme focussed on reflections on the work carried out by pharmacy staff during the screening process. This included the ‘result giving’ process and pharmacist reflections on tailoring results and advice. The final theme focusses on pharmacist views on the working relationship they share with local GPs.

Results are discussed in the context of findings from previous studies focussing on similar themes including the way in which the results inform some of the findings of the previously presented quantitative data for the main PRISM screening study. Further implications for HCPs working in this field together are discussed followed by guidance for future research in this area.

5.2 Methods

5.2.1 Aims and objectives

The primary aim was to gather pharmacists’ views and experiences of the feasibility and acceptability of the PRISM screening study. Ancillary areas of interest included: how pharmacists discussed screening test results with
participants during consultations, their reflections on the relationship with participants during screening consultations and finally their perceptions on their working relationships with local GPs.

5.2.2 Sampling and recruitment

I was keen that the qualitative study should include staff from all pharmacies that had participated in the PRISM study and who had recruited over 30 participants. These selection criteria aimed to ensure that the pharmacists interviewed had experience in delivering the screening service to participants with varying LSA risk scores and blood test results (high, medium and low). Initially, only qualified pharmacists were invited to take part. The inclusion criteria were then broadened to include pre-registration pharmacists (pharmacy students in the final year of training) provided they met all other inclusion criteria. This was done to provide a larger pool of potential participants but also to ensure that a wider range of views and reflections (in terms of years of experience) were considered in the analysis.

Eligible pharmacists were sent an invitation and leaflet explaining the purpose of the qualitative study. Interested pharmacists were asked to send back a reply slip by post. For pharmacists who did not send a reply form, a follow up phone call was made. All eligible pharmacists that were invited agreed to take part in an interview.

Ideally I would have continued to recruit pharmacists to this study until data saturation had occurred and no new themes were emerging during interviews. However, the overall study sample size was limited by the number of pharmacists that were eligible to be invited to take part in an interview.

5.2.3 Data collection methods

One to one semi-structured interviews were carried out between May 2013 and January 2014 at each pharmacist’s place of work. All interviews were audio recorded and transcribed verbatim. Interviews were based on an initial flexible topic guide designed to explore and expand upon the initial research questions.
5.2.4 Topic guide

The initial topic guide was designed to reflect the overall study aim of exploring pharmacists' views and experiences of the screening methods used. The topic guide was split into two parts, the first focussed on the feasibility and acceptability of the screening service. Topic areas included: barriers and facilitators to recruitment, management of appointments and performance of testing equipment. The second part of the topic guide focussed on interactions during screening appointments, including: the delivery of screening test results and subsequent lifestyle advice. This component of the topic guide was designed in a slightly less structured way initially, including more open ended questions to allow a greater exploration of the different themes which emerged from the interviews.

Further refinement of the topic guide happened during the study, informed by the constant comparison approach\textsuperscript{130,131} which allowed unanticipated themes which emerged in early interviews to be further explored. The final version of the topic guide used is included in appendix three.

5.2.5 Data analysis

Data analysis was informed by the constant comparative approach and framework charting\textsuperscript{132,133,134}. This combination of approaches was chosen to ensure that findings emerged from, and were thus grounded in the data. The framework charting facilitated a structured process for organising the data.

Preliminary analysis was conducted at several stages during data collection. This informed areas to be explored in depth in future interviews and the development of an initial coding framework. Once all interviews were completed and transcribed transcripts were read and re-read, emerging themes formed the initial coding framework. Broadly the coding framework reflected the aims of the qualitative study in that it was divided into two sections; feasibility and acceptability of the screening methods, and patient interactions during the screening process.
A key theme that emerged during the initial interviews was the way in which pharmacists interacted and worked collaboratively with local GPs and practice staff, and this formed a new theme which was added to the coding framework.

The final coding framework consisted of the three main themes as ‘codes’ with more specific ‘sub codes’. This coding framework was then used to allow a systematic coding of the transcript data. Each individual transcript was re-read and coded using the coding framework using Nvivo (version 10) to facilitate coding. The coding framework used in the analysis is included in appendix three.

Whilst assessment of validity is not a requirement for qualitative research\textsuperscript{135} \textsuperscript{136}, in order to check interpretation of data analysis, a sample of transcripts were shared with a supervisor (HE) who mimicked the analysis process. I met with my supervisor a number of times during the analysis process to discuss and compare themes.

5.3 Findings

5.3.1 Sample

The final study sample included 16 pharmacists from 12 pharmacies involved in the PRISM study. Demographic information for the study sample is presented in table 8 below. Briefly, the sample included a larger proportion of male (n=12), SA (n=12) and 30-40 year old participants (n=8).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Gender</th>
<th>Age group (years)</th>
<th>Ethnicity</th>
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<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>20-30</td>
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<tr>
<td>16</td>
<td>12</td>
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When presenting data in the following sections I will use the term ‘pharmacists’ to refer to the pharmacists who were interview participants in the qualitative study, and ‘participants’ to refer to pharmacy customers recruited and screened as part of the PRISM screening study.

### 5.3.2 Feasibility and acceptability of the screening process

When describing their overall thoughts and feelings of being involved in the screening study all of the pharmacists indicated that they felt that their participation had benefitted both themselves as professionals and their pharmacy as a whole. Many of the less experienced pharmacists felt that providing the screening gave them an opportunity to improve both their knowledge of diabetes and their consultation skills through increased contact with participants and the need to interpret and explain screening test results.

> ‘I think the whole thing, the whole process I have learned a lot… I have learned how to cope with scenarios of when the patient is in a rush, I have learnt about how you deal with different types of patients and obviously I have had to learn about diabetes in more depth so I can explain to the patient what it is’ (INT P12, SA, M, 20-30)

Pharmacists universally described positive feedback from participants following a screening appointment.

> ‘So they are just grateful that they have been screened, we have had a couple of patients that have gone onto being diagnosed with diabetes. Now the feedback we are getting from them that luckily they were screened when they were, and to think that it could have got worse and the patients are saying that it’s better to catch it now than later on. So they are glad that it’s happened when it has’ (INT P10, SA, M, 40-50)

The financial incentives offered to pharmacists on a ‘per-participant screened’ basis were considered fair and was described as possible new source of funding for pharmacies.
‘I think services like this one are an active approach to the community to do things more is a good way to source an income’ (INT P10, SA, M, 40-50)

In contrast to this view, one pharmacist felt that if offered a similar study again they would need more evidence of cost-effectiveness before they would consider taking part. This pharmacist felt the extra staff costs involved in providing the service were too high compared to the payment that was made for carrying out appointments.

‘But if they evaluated it and it was cost effective for us to do it then I would jump on the bandwagon. But as it stands I would have to really really consider’ (INT P2, SA,M, 30-40)

This pharmacist concluded that without this information they would be unlikely to take up an opportunity to provide this service in the future due to increasing financial pressures at their pharmacy.

‘But as it stands I would have to really really consider. We’ve already lost a massive amount of staff hours per week and it has a big impact on our workload. So I think that in general pharmacy needs to be looking at doing more but the way that the finances are being clawed back, we would have to seriously question whether we would have enough time.’
(INT P2, SA,M, 30-40)

In terms of the equipment provided for the screening study, all of the pharmacists provided largely positive feedback regarding the HbA1c analyser, mentioning its reliability and consistency. Furthermore, in practical terms, one pharmacist described the analyser as a good size that fitted into the consultation room alongside other screening equipment.

The one drawback mentioned by four of the pharmacists was the requirement to carry out weekly internal and external QC testing on the analyser, the process itself was viewed as arduous and such frequent testing was unnecessary.
The calibration testing we have to do was a very laborious task’ (INT P1, SA, M, 30-40)

Two pharmacists reported experiencing minor problems with the testing machines. Both related to taking larger than required samples for tests. This was recognised as user error by the pharmacists involved and resolved by the pharmacist without the need for assistance.

In summary, pharmacists generally found the overall screening method and equipment to be feasible and acceptable to both themselves and their customers with a minority expressing concerns over the cost implications of providing this service.

5.3.3 The screening process – Part 1. Pharmacists’ experiences of adapting the screening to suit the needs of their pharmacy

Involvement of pharmacy staff

Pharmacists described how the PRISM study was operationalised in their pharmacy. In all of the pharmacies the pharmacist had overall responsibility for recruitment of participants. At a number of the pharmacies, however, other members of the pharmacy team such as pre-registration pharmacists and pharmacy technicians were given responsibility for some study procedures such as identifying potential participants. Pharmacists who did delegate these duties reported overwhelmingly positive outcomes as a result of integrating other staff into the screening process. In particular, it was recognised that pharmacy technicians and counter staff experienced a higher frequency of customer interactions on a daily basis and were thus able to approach a higher number of potential study participants than the pharmacists themselves.

‘It was easier to recruit by involving the whole team…the counter staff have most face to face contact with customers’ (INT P1, SA, M, 30-40)

‘if they are handing out 5 or 6 prescriptions per hour, that’s 5 or 6 patients they have contact with and they could easily recruit them if they wanted to’ (INT P1, SA, M, 30-40).
As well as identifying potential participants, pharmacy staff were involved in other areas of the study such as taking informed consent and assisting in the measurement of height, weight and BMI for the LSA risk score calculation. Five pharmacists reported how involving their whole team had had beneficial effects on the organisation and management of the screening appointments. For example, having pharmacy technicians, pre-registration pharmacists and for some cases, more than one pharmacist on duty at any one time reduced the time spent by the on-duty pharmacist in the consultation room with the participant.

‘we managed to get some of the staff on board so they could take the height and weight measurements, waist circumference and that, so most of the things can be populated for the pharmacist and we can just quickly sit down get the [LSA] risk score, get the envelopes, do the ethics part of things, consents, and do the actual test’ (INT P1, SA, M, 30-40)

An additional reported benefit of involving the wider pharmacy team was an impression of raised motivation across the team having played a role in a participant’s diagnosis of T2DM. Pharmacists mentioned the value to the patient’s health of an earlier diagnosis and reported how playing a part in this resulted in feelings of improved morale and job satisfaction for pharmacy staff.

‘It lifts the whole team even when you find somebody who you know that pretty much that they have diabetes, we found a fair number of those, it’s quite sad that it still lifts us that basically they can now get the right treatment and hopefully prevent complications further down the line’ (INT P12, SA, M, 20-30)

‘We are healthcare professionals yet quite often 90% of our work is just dispensing technicians work so it’s very rewarding for the whole team because everybody has been involved and I think that is a successful service here’ (INT P3, SA, M, 20-30)

One additional, and perhaps unanticipated benefit to pharmacy technicians, was the impact on their own health through improved awareness.
The counter staff have improved their skill level and diabetes knowledge and even become healthier themselves’ (INT P6, SA, M, 50-60)

The benefits were also not just viewed as short term. Two of the pharmacists described a legacy effect resulting from improved knowledge and understanding of T2DM and its risk factors and improved skills in communicating with customers amongst all members of the pharmacy team.

‘I have learned how to cope with scenarios of when the patient is in a rush, I have learnt about how you deal with different types of patients and obviously I have had to learn about diabetes in more depth’(INT P12, SA, M, 20-30)

**Management of screening appointments**

Involvement in the screening study inevitably increased demand on the pharmacy staff due to an increased number of appointments and time needed to process paperwork relating to the study. Pharmacists described ways in which this increased demand upon staff time was managed.

Although participants were generally recruited opportunistically, four pharmacists found that offering some participants the chance to book appointments in advance for a later date was mutually beneficial to both the participant and pharmacist. Using an appointment booking system allowed some pharmacists to avoid conducting screening at busy periods in the week. One pharmacist felt that this booking approach offered greater flexibility with regards to booking than GP appointments and was more appealing to participants and easier to manage.

‘Because you only have a small number of appointments you can micro-manage them, phoning people up the day before writing out appointment cards etc’ (INT P3, SA, M, 40-50)

Pre booked appointments did have one drawback, a high rate of non-attendance to these appointments was recognised as a problem by two pharmacists and one pharmacist recognised this as a major problem in
recruiting participants for the study overall. However, some pharmacists were pro-active in addressing non-attendance by using appointment cards or phoning 24 hours before the appointment to remind participants and confirm attendance.

‘We try to phone up people before appointments and fill out appointment cards to reduce the number of people forgetting their appointment,’ (INT P3, SA, M, 40-50)

**Recruitment of participants**

When discussing the way in which potential participants were identified, a number of different strategies were described by pharmacists, but these fell broadly into three types of approach: ‘systematic-opportunistic’, ‘ad-hoc-opportunistic’ and participant initiated. There was no consensus on which was the most successful and the majority of pharmacists reported using a combination of the approaches which are described in detail below.

**A ‘systematic opportunistic’ approach**

Three pharmacists reported that they had conducted systematic searching of an individual’s eligibility criteria using basic details recorded in pharmacy records. This was done while potential participants were present but engaged with other core services at the pharmacy such as MURs, NMRs or stop smoking services. Pharmacists identified potentially eligible participants from those attending these services and gave them study information and an invitation to re-attend the pharmacy if they were interested in taking part in the study.

‘We’ve had some that have come in may be done an MUR and they thought that I can come and do this and you explain about the study and stuff and if they are happy they will do it’ (INT P3, SA, M, 40-50)

**An ‘ad-hoc opportunistic’ approach**

Four pharmacists described what was viewed as more of an ‘ad hoc’ approach to recruiting participants, but this was conducted in different ways; in two pharmacies the counter staff were given instructions to ask all walk in patients if they would be interested in taking part.
‘so many walk ins patients are just asked ‘there and then’” (INT P5, SA, M, 40-50)

The two other pharmacists reported being more discerning; they described using visible risk factors for T2DM, such as waist size, ethnicity and age to help them identify potential candidates, and reported being able to accurately gauge a participant’s risk of T2DM using these visible risk factors.

‘You could tell by his waistline that it was slightly above the 90cm so it was you know a little bit cause for concern. He wasn’t smoking but he was chewing tobacco’ (INT P10, SA, M, 40-50)

‘Obviously people … you can tell straight away when you look at the body frame of a person whether that person would want a screening then, because somebody slim coming into your pharmacy, you know that okay, you can do a risk assessment on them, but it will not lead to a test’ (INT P6, SA, M, 50-60).

One pharmacist spoke about how they used their estimation of several potential risk factors when trying to recruit participants. They described this as ‘cherry picking’ to give the best chance of identifying people at high risk of T2DM. Again, visible risk factors (age, ethnicity and in particular weight and waist size) as well as risk indicated by participants’ current medication regime were key to this decision making.

‘I didn’t feel like asking any tom dick or harry, I wanted to pick out the high risk patients…all I’m saying is that if you know your risks, you know what the high risk patients are going to look like or what meds they’re on’ (INT P2, SA,M, 30-40)

A ‘participant initiated’ approach
Other pharmacies relied on ‘participant driven’ recruitment. For example, by displaying publicity material provided by the study team (for example, posters or flyers) resulted in participants enquiring about the screening offered without being asked or prompted by pharmacy staff.
Pharmacists reported that a common motivator for self-referral to the screening study was a friend or relative recently being diagnosed with T2DM. It was suggested that participants were motivated to undergo a screening test to seek reassurance in the knowledge that familial history of T2DM was a strong risk factor for developing T2DM and IGR.

‘People ask after their family have been diagnosed’ (INT P7, SA, M, 30-40)

‘but she came in because well she did that but also her sisters have been diagnosed as well. So she was worried anyway’ (INT P7, SA, M, 30-40)

Similarly, a ‘snowballing effect’ was achieved via a ‘refer a friend’ scheme in one pharmacy: participants completing the screening were requested to ask a friend to book an appointment if they themselves found the screening appointment useful. This pharmacist reported this to be effective in significantly improving recruitment.

**Challenges to recruitment**

Not all of the pharmacists found the recruitment process easy and some did not manage to adapt the process effectively to suit their pharmacy. The most common barrier given by pharmacists was the time needed to carry out screening appointments and complete the consent process prior to the screening. Furthermore, one pharmacist reported some hesitancy from potential participants at having to sign documents prior to the screening, as well as annoyance if the appointment took longer than they were prepared to wait.

‘Nobody wants diabetes, but nobody wants to do anything about it. People just want a quicker test…people don’t like signing something and the length of appointment’ (INT P1, SA, M, 30-40)

When explaining why time was a barrier, pharmacists described competing demands on their time from other core services such as smoking cessation and MURs.
One of the pharmacists cited a recently introduced piece of legislation as a key barrier to increased pharmacy participation in screening programmes in general.

‘There is something called ‘category M clawback’. And that minimises the amount of profit we can make per drug. That has a massive negative impact on your gross margins test’ (INT P2, SA, M, 30-40).

Category M is part of the drug tariff reimbursement system agreed as part of the community pharmacy contractual agreement. The system places a cap on the financial reimbursement pharmacies can claim back as part of the NHS pharmacy contractual framework for around 500 different medications. Reductions in the cap in the form of claw backs can limit or reduce the profit margin on commonly provided medications\(^{137}\). In limiting the profit margins from the most common drugs, pharmacists have to increase efficiency within the pharmacy and many have had to reduce the number of staff on duty. This limits the availability of staff to offer additional services such as health screening as they must prioritise their key duty to dispense medication and offer commissioned services as part of their NHS contract.

5.3.4 The screening process - Part 2. How pharmacists adapted the screening to suit the needs of their customers.

**Level of participant engagement with screening**

Pharmacists reported how challenging situations often arose during discussions prompted by a ‘high’ screening result (risk score ≥16 or HbA1c ≥6% (≥42mmol/mol)). When commenting on this issue three pharmacists described the difficulty they experienced when participants were not very receptive to either the screening result or further advice. A clear distinction was drawn between participants who asked more questions and thus seemed to be more ‘engaged’ in the consultation following a screening result, and those who were less engaged.

‘I have had some patients who just have an almost blank face and don’t really know what is going on’ (INT P11, SA, M, 30-40)
Pharmacists hypothesised that the level of engagement may be influenced by a participant’s age and ethnicity, in that participants seemed to associate these with a sense of inevitability of being diagnosed with T2DM. For example:

‘Obviously the higher, the older patients are fine you know especially the fifty, fifty five plus patients…, they are quite keen to have the tests. But the younger age bracket they would rather not’ (INT P11, SA, M, 30-40)

‘I have seen a lot of people who they almost accept that they are going to get in one stage of their life yeah, they just think it’s the norm and trying to actually say well no if you adopt behaviours that would potentially reduce your risk’ (INT P3, SA, M, 30-40)

‘I don’t know whether it’s a, I don’t think it’s a language barrier I just think they [South Asians] think it’s something normal that is going to happen in their lives’ (INT P8, SA, F, 20-30)

Pharmacists described how they conducted the screening and framed advice differently depending upon how engaged the participant appeared to be. For example, with participants who were less receptive to advice, one pharmacist described giving a more forthright explanation of the level of risk to encourage the participant to take notice of the advice being offered.

‘Yeah, I had to do shock tactics, he just didn’t believe it, he was like “ah don’t worry about it”, I said,” look you need to go and see your doctor” ….Sometimes you have to be frank with patients otherwise if you don’t, they don’t understand the severity of the condition that they might have’ (INT P12, SA, M, 20-30)

Pharmacists’ perception of the participants’ level of fear or anxiety also influenced the way in which they gave feedback on screening results. Nine of the pharmacists reported consultations with participants who were scared both prior to the screening and after an explanation of their results.
'Many patients, they’re just really scared beforehand, they just don’t want to know. They go "No, I don’t want to know just in case if I’m diabetic", then they just don’t want to know' (INT P5, SA, F, 20-30)

‘One of them, a gentleman was worried before he did a test about “you know my mum is diabetic” this and that’ (INT P8, SA, F, 20-30)

In some cases, pharmacists realised that anxiety and fear was linked to the participants’ future implications for employment as a result of a positive screening result and confusion with type 1 diabetes.

‘I have about two or three patients who are like drivers and they are if they have type 1 diabetes they will get sacked straight away’ (INT P12, SA, M, 20-30)

Pharmacists reported that levels of anxiety in participants were at their highest once they had been told that results were such that a follow up appointment with their GP was required.

‘so when I told him, he was like, “oh my god I know I am going to die like my mum”’ (INT P8, SA, F, 20-30)

In terms of managing such fear and anxiety in their participants, one of the pharmacists spoke about treating the participant like a ‘friend’ instead of dictating information in an authoritarian style. While maintaining a professional manner, he used humour to diffuse this anxiety and relax the participant prior to the result giving.

‘whereas this particular person, you almost have to befriend them and so your manner is slightly more relaxed and because it’s more relaxed it’s not that you are making light of the subject but in fact you are actually talking to them rather than at them’ (INT P3, SA, M, 30-40)

**Discussing positive results with participants**

Pharmacists described high levels of anxiety in participants following the receipt of a positive screening test result (risk score ≥ 6% and/or HbA1c ≥
6%≥42mmol/mol). In some cases this was a cause for concern for the pharmacists themselves. For example, one pharmacist was concerned about the implications of giving a positive test result. This pharmacist was concerned that the experience may damage or change the relationship between pharmacist and participant and lead to participants avoiding the pharmacy from then on.

‘at this point in time people then avoid the pharmacy because we are then the enemy, we have now identified that he is a high risk patient’

(INT P10, SA, M, 40-50)

Pharmacists spoke about the different ways in which they managed this. For example.

‘I think the way I approached it was that I don’t want to do any scare mongering, that’s one very important thing, because the patients already worried anyway they are worried even before they have stepped into this room’ (INT P1, SA, M, 30-40)

Many of the pharmacists attempted to alleviate participants’ anxiety by reinforcing the positive message about the benefits of an earlier diagnosis. In these cases, pharmacists highlighted that action could be taken to reduce their risk of developing diabetes or complications associated with T2DM.

‘Don’t worry about anything, because we can always do something about it, it’s not the end of the road yeah right, it happens, the doctor may tell you to make some lifestyle changes, may start you off on medication but whatever it is we can support you’ (INT P1, SA, M, 30-40)

When dealing with participants who were not concerned about their positive screening test result, pharmacists reported taking the opposite approach to that mentioned above. Rather than working to minimise anxiety, they emphasised the danger of a high screening result to raise anxiety and ensure that the participant recognised the importance of the result and attended a follow up screening appointment.
'a patient with a laid back attitude, you get the feeling that this guy isn't going to go even if I referred him right this second, you would almost want to put a bit of fear factor in him' (INT P2, SA,M, 30-40).

Pharmacists reported finding the LSA risk score (provided for use in the screening) helpful as a reference when giving test results and discussing contributing factors to a high LSA risk score or HbA1c result.

‘Because I think the consultation had led that way because we’ve been talking to him all the way through and talking through the risk scores, it was no surprise to him’ (INT P3, SA, M, 30-40)

In particular, pharmacists found the LSA risk score helpful in explaining the difference between modifiable and non-modifiable risk factors and in suggesting ways to reduce risk of T2DM.

‘I always sort of mention the ones that you are in control of and ones you really aren’t so if they have a got high score but a low rating then it will most likely down to those sort of factors’ (INT P7, SA, M, 30-40)

Pharmacists described how they first did an informal assessment of a participants’ needs and/or emotions and then attempted to explain the results in a way that fitted these. They felt that by doing this, the participant accepted the result and understood the implications.

‘Because I think the consultation had led that way because we’ve been talking to him all the way through and talking through the risk scores, it was no surprise to him’ (INT P3, SA, M, 40-50)

In the case of the screening identifying a participant’s HbA1c as very high risk (>12% (>107.7mmol/mol)), two pharmacists reported taking direct steps to ensure that the GP was made aware of the result. This was done either by an immediate phone call to the GP or by accompanying the patient to the practice reception desk to speak directly with practice staff. Pharmacists felt that the study referral methods were insufficient for ensuring that very high risk participants would attend a follow up test, thus direct intervention was deemed
necessary on their part.

**Discussing ‘borderline’ results**

I specifically asked pharmacists how they dealt with test results either on, or very close to the referral threshold. I was keen to establish specifically how pharmacists explained screening results close to this threshold.

Pharmacists’ accounts demonstrated how they frequently used the term ‘borderline’ when dealing with such results and these discussions were described as challenging by some of the pharmacists.

> ‘I do normally say “borderline. This is not to say if you increase your result by 0.1% you will definitely get diabetes, but you are borderline so you need to keep an eye on things”'(INT P4, SA, F, 20-30)

Four of the pharmacists reflected on the nature of the participant’s response when told they were at ‘borderline’ risk. Participants seemed to treat this type of result in different ways.

> ‘When you tell them that they are ‘borderline’, they realise oh my god now it’s almost a wakeup call for them I think yeah’ (INT P8, SA, F, 20-30)

In contrast to the anxiety described in some participants, pharmacists described how others were less affected by a screening result close to the referral threshold. This is shown by the quote below.

> ‘There was one or two that I did, female, who were not really bothered, really weren’t bothered [with a borderline result], which was odd because you tend to think that [it may be the case for] men, you know’ (INT P2, SA,M, 30-40)

When explaining these results, a common strategy used by pharmacists for participants with a result just below the referral cut-off was to emphasise the need for re-testing after a period of time. This ranged from 4 months to 1 year
depending on the pharmacist. The participant was encouraged to return to the same pharmacy for the test.

‘We also reinforce that they do need to maybe come back in a year’s time or a contact a healthcare professional in a years’ time’ (INT P3, SA, M, 40-50)

‘maybe after a couple of months or so come back again and we might do your diabetes level check again or go back to your GP and check whether this figure has been reduced or not reduced’ (INT P5, SA, F, 20-30)

Encouraging follow up of raised screening results could be viewed as another legacy effect of offering this service as well as improving the staff skillset within the pharmacy. Although this may have been an unintended consequence, two pharmacists recognised that by inviting previously screened participants to return for a re-test, the pharmacist established a continuous monitoring relationship with the participant which could be maintained in the long term.

**Discussing negative results**

When providing feedback to participants with a low LSA risk score, pharmacists described how they focussed on reinforcing healthy behaviours related to diet and exercise and a general message to ‘carry on with what you are doing’.

‘I would say continue doing exactly what you’re doing, because it’s very good what you have done right yeah, erm, and maintain it, if you can watch what you’re eating, exercise if you’re not already exercising’ (INT P1, SA, M, 30-40)

‘I reinforce the positive messages and advising them that they need to continue with these behaviours’ (INT P3, SA, M, 40-50)

Two of the pharmacists recognised that participants who had a low blood test result may remain in a high risk of T2DM category in terms of LSA risk score. Pharmacists identified that these participants may need to take action to lower
their risk of T2DM in the future, thus felt it was important to advise them accordingly.

‘the fact that they needed a HbA1c test suggests that their risk factors were high, so I would probably still counsel them on lifestyle, exercise, diet and weight, things like that’ (INT P4, SA, F, 20-30)

Again, pharmacists used the LSA risk score sheet to identify and explain modifiable risk factors when giving this advice and suggest ways in which they could lower their risk of T2DM further.

‘we gave her the diet sheet because she didn’t need to work on her weight or her blood pressure or anything else at the moment’ (INT P10, SA,M ,30-40).

As part of delivering advice following the screening, pharmacists also stressed the importance of getting re-tested every 6-12 months. Four of the pharmacists directly offered the patient the opportunity to return to the same pharmacy to have this carried out.

‘but within say eight to twelve months to come back and to maybe use one of our paid services if her doctor is not willing or committed to her checking to keep an eye on it’ (INT P10, SA, M, 40-50)

**Other resources to aid communication of results**

A high proportion of pharmacies were located in geographical areas populated by high numbers of people from black and minority ethnic (BME) groups, most frequently people of SA ethnicity. Pharmacists spoke about the differences they found in conducting some screening consultations with SA participants compared to consultations with WE participants.

As described earlier, three pharmacists reported a finding that SA participants more commonly disclosed a sense of inevitability of being diagnosed with T2DM.
‘There’s an acceptance that they will get diabetes if they are Indian…they think it’s the norm’ (INT P1, SA, M, 30-40)

‘It’s normal that the patient will get diabetes at some point in their life’ (INT P8, SA, F, 20-30)

However, one pharmacist discussed the challenges of recruiting participants from BME populations.

‘Recruiting is difficult in ethnic groups, lower uptake rates than in white groups’ (INT P6, SA, M, 50-60)

Whilst three pharmacists described a sense of ‘normalisation’ regarding diabetes in the BME population, one pharmacist attributed recruitment difficulties to the stigma attached to diabetes together with the attitude that diabetes may be considered a taboo subject.

‘These guys are hard to reach because I think, either they’ve got stigma with being labelled as diabetic if they find one, or they don’t want to know. It’s a territory not treaded upon and that’s fine. That’s the attitude they’ve got’ (INT P6, SA, M, 50-60)

The majority of pharmacists reported having to take extra time to explain the various factors which affect risk of T2DM and challenge participant misconceptions in SA groups in particular. By doing this pharmacists felt that despite the increased difficulty and complexity, knowledge and understanding of ways to reduce risk of T2DM was improved in all screening participants following a consultation.

‘I have seen a lot of people who they almost accept that they are going to get in one stage of their life, yeah, they just think it’s the norm and trying to actually say “well, no, if you adopt behaviours that would potentially reduce your risk, yes the fact that you are South Asian is always going to score high, the fact that you are male is going to be score high, the fact that your mother and father had it will score you high, but you know eating the right portions, taking regular exercise and eating the right foods, those things will significantly reduce your risk of getting it and if
not reduce your risk, they will delay the onset”. I think that has been a real challenge, that’s been what we had to adapt’ (INT P3, SA, M, 30-40)

The ethnicity of the staff working at each of the pharmacies carrying out the screening was commonly reflective of its customer base. Usually this resulted in pharmacy staff having not only the appropriate language skills but the personal experience of growing up in the respective cultures which allowed acknowledgement and sensitivity towards commonly held beliefs during screening consultations. This shared characteristic between pharmacist and participant was emphasised in the delivery of culturally relevant advice. One pharmacist reflected on the effect of this.

‘Exercise if you’re not already exercising, but it’s not a passport to, you know, a life free of diabetes, because of our ethnicity we are still at high risk, so continue doing what you’re doing, and just keep on improving on what you’re doing”. I think that you should give them a bit of praise, yeah right’ (INT P1, SA, M, 30-40)

Pharmacists strongly emphasised that this shared culture was helpful alongside the pertinent clinical experience and knowledge within each pharmacy to enable staff to deal with participants on a more personal level during consultations. In some cases this extended to educating participants on beliefs regarding herbal medications. One pharmacist acknowledged that use of alternative therapies as a substitute for prescription medication may be more prevalent in the SA population.

‘We also find that although they have been diagnosed and might be taking something for their diabetes they also rely on … (herbal) medications as well in this area so they most probably stop the conventional medication and go for herbal medication in its place’ (INT P1, SA, , 30-40)

A small number of the screening consultations were conducted with participants who did not speak English, most commonly in Gujarati, Urdu and Punjabi.
However, pharmacists expressed some concerns over their ability to deliver translated consultations.

‘We have difficulty in translating meaning and promoting complex understanding in a different languages’ (INT P10, SA, M, 30-40)

Two pharmacists felt that they did have the appropriate skills within the pharmacy to deliver translated lifestyle advice. In these cases, they used external online resources to assist in giving lifestyle advice.

‘The language barrier used was a bit of a problem but not as significant as thought...we use translated materials from diabetes UK website.’ (INT P4, SA, F, 20-30)

Two of the pharmacists printed out information translated (externally) into the study participant’s mother tongue.

‘We actually use the NHS Diabetes [website] for specifically NHS choices have videos on there, now if you use the NHS Choices Diabetes UK it actually has it on there in different languages and what we do is we find out their preferred language like Urdu, Punjabi, Gujarati and you print out’ (INT P10, SA, M, 40-50)

In summary, the pharmacists’ experiences captured regarding the methods used to communicate lifestyle advice and screening results showed a variety of methods being used to help communicate and educate. This showed how pharmacists had used their own skills and initiatives above and beyond the study protocol. The decision as to which method to use was predominantly based on the pharmacists’ perceptions of participant’s individual needs.

Pharmacists used both study resources and external resources translated into other languages to assist in the communication of lifestyle advice and screening results, particularly for those with limited English language. The consensus amongst pharmacists was that by doing this understanding of the implications of screening results was good amongst participants.
5.3.5 The relationship between pharmacists and local general practice staff

As a consequence of taking part in the screening study, pharmacists referred a high number of ‘high risk’ participants to their local general practice for follow up. This led to an increase in frequency of contact between pharmacists and local GPs. During the interviews a prominent theme emerged around pharmacists’ perceptions of the relationship with local GPs. It became clear during the interviews that this relationship was key to the success of the screening carried out. I was keen to develop this theme further to understand the barriers and facilitators to a good working relationship between the two sets of HCPs and in turn to the way in which pharmacists felt that it impacted upon the way they carried out the screening.

Generally, when speaking about the relationship with local GPs, pharmacists reported good levels of collaborative working and recognised their shared priority of patient safety.

‘I think we work very very well with GP’s in general, I think we have a common goal, number one is patient safety’ (INT P1, SA, M, 30-40)

In the context of screening, and in particular the situation of referring participants found to be at high risk, there was some apprehension from pharmacists who did not want to be perceived to be repeating work or advice which had already been carried out by GPs. There was also the fear of contradicting information or advice already given to participants by GPs.

‘Sometimes, you know it’s like, are we stepping on peoples toes, are we not stepping on peoples toes., are they going to like what we are doing, did they actually listen to anything that we are saying, it’s that sort of balance that we have got to achieve’ (INT P1, SA, M, 30-40)

This fear of repeating work GPs had already carried out appeared to be caused by pharmacists not wanting to compromise their relationship with GPs but also to ensure that participants were not confused with conflicting, or too much information from different sources.
Pharmacists also reported dealing more commonly with other practice staff than directly with GPs, and in some cases this was discussed in more favourable terms. For example, collaboration with practice nurses was perceived by one pharmacist as more of a two way process. It was reported that nurses contacted the pharmacy for general advice more frequently than GPs. GPs tended only to contact the pharmacy with specific queries relating to prescriptions.

‘I think our relationship with the nurses is better than they are with the doctors, I can phone the nurse and say right this patient has been changed at the hospital from this to this can you do it, yeah what is it, having that trust with me’ (INT P2, SA, M, 30-40)

‘I speak to the nurses every day, they phone for advice, we can’t get hold of this, this patient, they know that our main interest is their patients and they appreciate that’ (INT P2, SA, M, 30-40)

In cases where pharmacists contacted the GP directly due to an abnormally high HbA1c result (>12%/>107.7mmol/mol), six pharmacists reported that they had little or no feedback from GPs following the referral. Only one pharmacist reported direct contact with a GP. All of these pharmacists said they would have liked more feedback from the GP surgery.

‘I suppose that in some ways [it] has not worked well because I would have hoped when I have identified high risk patients which we have, numerous ones I would have hoped that the GP would have maybe given us some feedback to say “thank you very much” or “thank you and now I am taking over the care of this patient’ (INT P3, SA, M, 30-40)

There were a number of barriers which were seen to limit collaboration with local GPs. The most commonly reported barrier identified was the geographical distance between the pharmacy and GP surgery. The pharmacies that participated in the PRISM study were located in a range of settings. Four of the pharmacies were located in the same building as a GP surgery and the remainder were ‘high street’ pharmacies. The high street pharmacy customer
base tended to be registered at a number of local practices whereas pharmacies that share premises with a practice tended to see a majority of customers from the practice with which the premises was shared. Consequently ‘high street’ pharmacy staffs experienced a lower number of day to day dealings with the same practices and the length of time taken to build up a collaborative working relationship was significantly lengthened. Pharmacists reported the difficulties that this entailed.

‘our patient base is quite wide, particularly older patient or previous patients from (old pharmacy shop), the challenge that we have had is engaging with those other GPs and other services’ (INT P3, SA, M, 30-40)

‘if you’re on the high street you can’t do that, you’re relying on delivery drivers, relying on telephone calls, relying on other people to pass on the message’ (INT P1, SA, M, 30-40)

Four pharmacies were located in the same building, or next door to the practices they served. This promoted more frequent, and in most cases face to face contact with practice staff.

‘yeah me going to reception and saying look these are my queries, this is quite important you know’ (INT P1, SA, M, 30-40)

‘if the GP surgery is near where you actually work, that’s helpful, because we can chase things up and maybe get things sorted out a little bit earlier than later’. (INT P1, SA, M, 30-40)

Other factors inhibiting this working relationship were related to personal characteristics. Two pharmacists perceived that age and seniority of the GPs were both barriers to collaborative working. These pharmacists reported having a better response to queries and requests from younger GPs.

‘You know young isn’t the right way of putting it. But they [younger doctors] tend to be easier to work with than the older ones,… the senior partners’ (INT P2, SA,M, 30-40).
Two pharmacists felt that taking part in the PRISM study had directly improved levels of collaboration with their local practice. For example, one pharmacy developed a more robust referral system including printing referral cards to take to GPs to streamline the process.

In summary, collaboration with GPs was mainly perceived as good from pharmacists’ point of view. However, there were concerns about the risk of repetition of screening tests and giving information which contradicted that being given by GPs. A number of barriers and facilitators to collaboration existed but the most commonly reported was the physical distance between the pharmacy and surgery itself. This affected the ease at which contact could be made with the practice and also the frequency of contact between the pharmacists and the practice staff, both of which were seen as important in building strong collaborative relationships.

5.4 Discussion

5.4.1 Summary of findings

Pharmacists generally reported the process and methods used to be feasible and acceptable. Moreover, they reported that provision of this type of service at their pharmacy had a number of positive outcomes for the pharmacy in addition to the number of participants diagnosed with T2DM. In particular, pharmacists described improvements in staff morale, job satisfaction, T2DM awareness and understanding of risk factors for T2DM.

The HbA1c analysis equipment and LSA risk score questionnaire used as screening tools for this study were deemed as suitable for future use by pharmacists. In particular, the LSA risk score had been helpful for educating participants on the difference between modifiable and non-modifiable risk factors during consultations as well.

The interviews demonstrated three broad themes regarding how pharmacists
worked to improve the effectiveness and success of the screening. Firstly, pharmacists adapted the service they provided to suit the need of their individual pharmacy by adapting and tailoring recruitment methods (eg. in terms of how and when potential participants were approached) to suit the organisational attributes of their pharmacy. Secondly, pharmacists described ways in which they adapted communication with their customers to optimise the screening process, while maintaining the pharmacist-consumer relationship. Thirdly, the interviews demonstrated how pharmacists sought to collaborate with general practices, and provided insight into barriers to this relationship.

5.4.2 Acceptability and feasibility of the PRISM screening

The majority view amongst pharmacists was that the screening methods tested were acceptable. The screening process as a whole, including the remuneration structure, was viewed as feasible by most of the pharmacists taking part with only one expressing concerns over the financial sustainability of the screening. Pharmacists reported a high level of confidence in the ability of the staff within their pharmacy to deliver this screening service.

Pharmacists described the different ways in which the screening was organised in their own pharmacy. The PRISM study was carried out in a pragmatic manner meaning that the necessary research procedures (consent and GCP) were provided, but flexibility was granted to pharmacists in terms of the day to day running of screening appointments to allow for the different needs of each pharmacy. This was important because pharmacies involved in the study were all very different, in terms of their size, number of staff, location and customer base, reflecting differences in community pharmacies nationally.

The degree to which pharmacists adapted their approach to each stage of the screening process varied between pharmacies. Some pharmacists tended to take a more active approach by encouraging all staff members to hand out promotional materials for example. Other pharmacies took a more passive approach to recruitment and relied on promotional materials displayed in the pharmacy to notify potential participants of the screening being offered.
Pharmacists also adapted the way in which they carried out the screening to suit the needs of their pharmacy. Pharmacists with a higher number of counter staff and pharmacy technicians were able to involve these staff members in the screening. For example, in helping fill out the LSA risk score, measure waist circumference and calculate BMI, which led to more effective management of the process, but also raised morale and sense of involvement in staff.

Pharmacists with fewer staff relied more heavily on a less opportunistic, more ‘appointment based’ system which helped them manage appointments within the constraints of their pharmacy.

The flexibility for organising the screening granted to pharmacists may have been one of the factors which enhanced the feasibility of the screening from the pharmacists’ perspective. Similarly, this may have been partly responsible for the level of acceptability reported by pharmacy staff taking part in the screening.

5.4.3 Barriers to the screening

Rate of recruitment varied dramatically between pharmacies during the recruitment period. The most commonly reported barrier to recruitment of participants (and feasibility of the screening in general) was the time taken to complete the extra appointments. Capacity of staff to complete extra appointments was limited by organisational constraints, such as their responsibility to deliver other contracted services which were linked to increasing financial pressure. Pharmacists reported that time constraints also applied to participants, with increased time spent completing informed consent procedures and filling out the baseline questionnaires. If this type of screening were to be rolled out on a national level, clear guidance may have to be considered to help pharmacists incorporate added responsibilities and duties into existing staff workloads.

5.4.4 The multiple roles of a community pharmacist.

As described above, there were three broad themes of work done by pharmacists to aid the success of the screening: adapting processes to suit
their pharmacy, adapting processes to optimise pharmacist-participant interaction, and seeking to collaborate with local practice staff. Analysis of the data emphasised the multitude of roles pharmacists adopted within this. In the following section I outline and describe these roles.

**Balancing participants’ emotions**

Pharmacists described how they tailored consultations to suit the individual participant, their level of engagement, knowledge and anxiety/fear. This was apparent in the way that they reported approaching potential study participants, and also the way they reported explaining results. This ability to identify and respond to patient cues has been reported in studies with other HCPs such as practice nurses who are specifically trained in patient-centred care\(^\text{138}\). This finding indicates the ability of community pharmacists to adopt a patient-centred approach during consultations which may be a relatively new concept in pharmacy compared to general practice and other fields of medicine\(^\text{139}\).

A key skill and requirement for pharmacists in the PRISM study was the need to interpret screening test results correctly and communicate them in a way that was understood by the participant. Pharmacists indicated that when explaining screening results to participants, they had sought to identify participant personality characteristics and anxiety levels in order to inform the manner in which they presented results. Pharmacists saw this as a key skill for managing participant emotions. They described how they adapted the explanation of a screening result to either minimise or raise the level of anxiety in the participant, in order to encourage the most favourable next step (eg attending the practice for a follow up test or modifying lifestyle).

Another essential part of communicating with participants was the challenge of a customer base from a multi-ethnic population. This was addressed by seeking culturally relevant resources and/or emphasising cultural awareness and drawing on a shared cultural identity.


Effective time and service management

It was evident in interviews that pharmacists used several strategies to ensure that running the screening service did not detract or impact on the successful delivery of other contracted services they were committed to providing. To do this, pharmacists described the organisational skills they used. One of these key skills was the effective management utilisation of the wider pharmacy team and their skills to optimise recruitment to the study without disruption to other pharmacy services being offered. A typical example of this was by training pharmacy technicians to collect measurements (height, weight, waist circumference). This reduced the amount of time spent carrying out screening with each participant by the on duty pharmacist.

Seeking to collaborate with other health care professionals

As a result of the high number of screened participants at each pharmacy, there was a high rate of referrals to local GPs when participants were found to be at high risk of T2DM. Managing the relationship with local GPs was seen as another necessary skill. Maintaining a good relationship with high levels of trust from GPs and practice staff was described as essential in ensuring that the recommendations of the pharmacist were acted upon. For some this meant actively contacting the practice or even accompanying participants to the practice to make an appointment. However there was also an awareness regarding not giving the practice the impression they were ‘stepping on their toes’ or contradicting their advice.

When commenting on levels of collaboration pharmacists generally reported good relationships with GPs. However pharmacists did describe better relationships with other members of practice staff. This finding is in keeping with results from previous studies of improving levels of collaboration between the two professions. However some pharmacists did disclose concerns that they may be repeating work that has already being carried out by a GP. This is a concern shared by GPs interviewed during a previous study. The authors of this study encourage greater collaboration between pharmacists and GPs to ensure that duplication of screening tests does not happen.
In summary, the finding that pharmacists took on multiple roles demonstrates how they worked in different ways to optimise the screening process. i.e by working to manage participants’ emotions, fostering links with GP practices and managing the time and resources within their pharmacy. The flexibility of the PRISM study allowed them to do this, and in turn contributed to the feasibility and acceptability of the methods used.

5.4.5 Contrasting the findings of the study with current literature

Evidence from the systematic review presented in Chapter 2 demonstrates the relatively low number of pharmacy based screening interventions for CVD risk factors including T2DM which have been rigorously evaluated\(^{142}\). As a consequence there are a low number of qualitative evaluations assessing feasibility and acceptability of similar screening methods used by community pharmacists. There are, however, a small number of studies which capture the views of pharmacists relating to the provision of services aimed at health promotion more generally. The most comprehensive systematic review in this area found that pharmacists perceived that public health was important to their practice, with over half describing themselves as ‘public health practitioners’. However, confidence amongst these pharmacists to provide services aligned with health promotion was low\(^ {83}\). The results of the current study are at odds with this. Indeed, the data indicates that both perceived ability and confidence amongst pharmacists to provide a screening service for T2DM was high. There a number of possible reasons for this disparity. Firstly the review by Eades et al\(^ {83}\) included studies conducted between 2001 and 2010. It is likely that pharmacists’ level of experience providing health promotion services may have changed over time.

Secondly, since the introduction of the new pharmacy contract in 2006\(^ {143}\), the role of pharmacy in providing services aimed at improving health has expanded. It is likely that as pharmacists gain more experience in providing this type of service, their confidence to do so in the future will increase. Similar levels of acceptability and feasibility of pharmacy-based screening were found in a more recent evaluation of a CVD screening pilot in Leicester city\(^ {129}\).
Structured interviews with the pharmacists taking part in the CVD screening indicated that having the opportunity to provide this service improved job satisfaction by providing a different facet to pharmacists’ normal daily routine and raised their professional profile\(^\text{144}\). It is important to acknowledge, however, that the way in which practices were recruited for the study could have influenced these findings relating to confidence to provide services such as screening. Pharmacists recruited to the PRISM study were self-selected from a pool of pharmacies that had previously taken part in a CVD screening study. Pharmacists chose whether they wanted to take part in the PRISM study and it is likely that pharmacists with low confidence in providing screening services may be less likely to accept an invitation to provide such a service.

The finding that time was the greatest barrier to carrying out pharmacy-based screening echoes findings of previous studies. For example, a recent qualitative study investigating the possible reasons for low levels of uptake to NHS health checks carried out in community pharmacies\(^\text{145}\) found that competing demands from other pharmacy services such as flu vaccinations impacted upon pharmacists’ ability to carry out the checks. Demand for pharmacists’ time has increased in recent years, evidenced by increase in both the number of prescriptions issued per pharmacy and the number of MURs being carried out\(^\text{146}\). Community pharmacists are spending an increasing proportion of time carrying out roles to provide pharmacy services aimed at improving health aside from their traditional role of dispensing medication. Pharmacy technicians are assuming new roles to provide services that were previously only provided by a trained pharmacist\(^\text{147}\). The changing nature of the role of pharmacy technician has been recognised and documented in recent literature\(^\text{147}\).

In the current study, involvement of pharmacy technicians and pre-reg pharmacists was reported as beneficial in helping recruitment and help manage the increased demand on pharmacists’ time from providing the extra service. These findings are in contrast to those from a recent evaluation of the pilot programme to offer NHS health checks through community pharmacy settings in the UK\(^\text{148}\). As part of this pilot, it was initially envisaged that pharmacists themselves would carry out the NHS health checks. Due to low rates of
recruitment and pharmacists' other time commitments pharmacy technicians were trained to deliver parts of the screening intervention. Despite this, all participating pharmacists reported being 'disappointed' with recruitment. Although the opportunity for skill development was acknowledged during this study, pharmacy technicians required more training than initially envisaged. The precise reasons for the difference in results between this study and the current study are unclear. One explanation could be that the complexity of the screening for NHS health checks was significantly greater than the PRISM study. In the previously published study, technicians were trained to complete blood tests in addition to the administrative aspect of the screening process. The authors of this study reported a lack of confidence in completing this task in some pharmacy technicians.

Findings from previous qualitative evaluations of implementing screening for T2DM in a general practice setting have more in common with the current findings. In particular, healthcare assistants taking on responsibility for the provision of screening within general practices have reportedly enjoyed the added responsibility associated with this service. Healthcare assistants also reported improvements in job satisfaction and self-esteem which is in agreement with what was reported by pharmacists interviewed as part of evaluation of the PRISM study.

5.4.5 Strengths and limitations of the qualitative evaluation of the PRISM study

Using qualitative methods has allowed in-depth exploration of the pharmacists' views relating to acceptability and feasibility of the screening methods used. In particular the iterative approach to development and refinement of the topic guide allowed me to develop the topic guide to explore new themes that emerged from earlier interviews to ensure that the resulting findings were reflective of the issues most important to the pharmacists taking part. Furthermore, this approach has allowed me to explore unanticipated issues such as the multitude of roles pharmacists adopt when carrying services such as screening. This data contributes to addressing a gap in the literature relating
to the evaluation of pharmacy based screening for chronic diseases including T2DM.

The main limitation of the qualitative evaluation relate to the constraints on sample size as the pool of potential interviewees was constrained by the number of pharmacists taking part in the PRISM study. The main practical implication of this was not being able to argue that data saturation had been achieved in all of the themes presented and discussed. In spite of this, my analysis indicated that no new themes were emerging relating to feasibility and acceptability of screening by the end of the interviews. That may not have been the case with other ancillary themes including the relationships between the pharmacists and practice staff for example. Hence, there may still be important relevant factors to further-explore in future research. One option for increasing the size of the sample would be to recruit a comparator group of pharmacists not taking part in the PRISM study and exploring in a hypothetical manner their views on the provision of such a screening service. It is likely that most pharmacists would have some experience of working collaboratively with GPs or discussing screening results with patients, which would have provided data on the broader picture of implementing pharmacy-based screening services.

Of the 16 eligible pharmacy staff from 12 pharmacies, all took part in an interview giving a 100% response rate. The relatively low number of eligible pharmacists did not allow sampling based on characteristics such as age, gender, ethnicity or pharmacy size/location. Despite this, the characteristics of the pharmacists that took part (Table 8) shows heterogeneity in terms of age, more males were recruited than females and the sample was weighted towards SA ethnicities. The most recent national level pharmacy census data reported 59% of pharmacists were female and that 13.1% were of Indian ethnicity\textsuperscript{150}. There are no data profiling the demographic characteristics of the pharmacy workforce in the UK by region which makes contextualising the characteristics of pharmacists from the current study difficult i.e in terms of the region sampled from.

Pharmacies were selected on the basis of high recruitment to a previous CVD screening study. As a result of this, it is possible that the ability of pharmacists
to provide this type of service may differ between pharmacists taking part in the PRISM study and pharmacies in the UK generally. I do acknowledge that although the qualitative evaluation carried out was successful in evaluating the acceptability and feasibility of the screening methods used, caution is needed when drawing conclusions regarding acceptability of these screening methods in pharmacies outside of the study.

Using the inclusion criteria of having recruited more than thirty participants over the study recruitment period resulted in staff from three pharmacies being ineligible for this study. I chose this inclusion criterion as I felt that it may not have been beneficial to interview pharmacists with little experience of carrying out the screening as attitudes and experience of delivering advice to participants with varying screening results may not have been formed sufficiently. On reflection, including staff from these additional pharmacies with lower recruitment rates may have provided more insight into barriers to the successful recruitment of participants. Staff from pharmacies that struggled to recruit participants during the study period may have not been able to share views and experiences relating to consultations with participants, but would likely have experienced greater barriers to recruitment of participants which would have been relevant to the overall goal of assessing feasibility and may have given a more balanced view of pharmacist acceptability.

On the topic of barriers, during the analysis it was clear that some of the views on barriers to the screening were in fact barriers to conducting research within pharmacies more generally. I felt it was necessary to draw a distinction between the two as some of the barriers to taking part in research may not be relevant to providing screening services for T2DM within a community pharmacy. For example, a key barrier reported by pharmacists was that participants did not like filling in the various forms and giving demographic details including name and address which was required for the study. Pharmacists also reported that the consent procedure took up a significant part of the overall time taken to complete the screening. Other barriers, such as time, may apply to both taking part in research and screening. The differences in reported barriers must be considered when interpreting the results of this
study. Transferring or contrasting of these findings to more general evaluations of screening which is not part of a research study must be made with care. It may be likely that many of the barriers to implementing such methods of screening as part of pharmacists’ day-to-day activities would be less significant without the tasks associated with recruiting the same participants to a research study. If screening was implemented (i.e not as a research project) there would be less form filling, and consequently, uptake may be higher.

The PRISM study has been recruiting for over two years in the majority of the pharmacies taking part. Interactions with the pharmacy staff over this time has inevitably led to familiarisation and development of strong relationships between many of the staff taking part in recruitment for this study and myself. When discussing issues around the acceptability of the screening methods used it is possible that non-disclosure of negative experiences or negative attitudes regarding the screening process overall may have occurred. It is equally feasible however that the relationships built over the recruitment period of the PRISM study may have fostered a better rapport during the interviews and more frank disclosure of both positive and negative views and experiences.

In addition to carrying out interviews and analysis I was also responsible for the management of the PRISM study. It is possible that this may have impacted on both the data generated during the interviews, and on my analysis of the interview transcripts. I attempted to address this by sharing interview transcripts with one of my supervisors who has a large amount of experience in methods of qualitative analysis.

5.4.6 Implications for current and future practice

This study has a number of practical implications for current and future clinical practice. Perhaps the most important implication would be in the future planning and implementation of screening interventions delivered through community pharmacies.

The results of this study highlight the way in which pharmacies adapted the screening to suit their pharmacy and the participants they recruited. When
implementing services in pharmacy settings it is often expected that pharmacy staff adhere to standard operating procedures (SOPs) and quality assurance measures to ensure a good quality of service is maintained. However, the way in which the PRISM study screening was organised and implemented at each pharmacy in terms of inviting participants, booking appointments and involving the wider pharmacy team differed according to the needs of the pharmacy. Allowing flexibility and giving autonomy over these decisions to pharmacists could ensure other similar services are implemented in a way which suits their pharmacy, hence hopefully also more effectively.

Skill mix and teamwork were reported as effective ways of delivering the screening intervention to a larger number of participants. Aside from the number of participants diagnosed with T2DM or IGR and followed up with the appropriate treatment, involvement in the study delivered clear benefits to all staff taking part. Feelings of increased job satisfaction and improved communications and consultation skills amongst pharmacy technicians and their contribution to the overall delivery of the intervention were reported by many pharmacists. The way in which pharmacy staff operate as a team, both in delivering the screening intervention as part of the trial and in the day-to-day dispensing and delivery of medication and other services was apparent during the interviews. In contrast, it is clear that the planning of some previous screening interventions has not been informed by knowledge of the contribution of the wider pharmacy team in the day to day running of pharmacies and this could be a limiting factor in successful implementation. Future screening interventions should take into account the roles that pharmacy technicians can play in order to best make use of their skills. This could be supported through an expansion of training programmes prior to implementation to include all pharmacy staff and further training to ensure continuity of appropriate skills for all pharmacy staff.

Finally, the results of this study suggest that pharmacists’ experiences and perceptions of their relationship with GPs are generally positive but could be improved. Pharmacists identified barriers to screening, such as vague referral systems and a fear of duplication of tests, or delivering advice which contradicts that given by a GP. Hence, more effective communication between pharmacists
and general practices could resolve much of this. Guidance documentation has been recently circulated to try to promote better relationships between the two professions. The results of this study suggest that this guidance is not routinely followed by both sets of HCPs, for example, lack of contact from the GP after a referral was made. At the least, pharmacists felt that some acknowledgement of the referral (a key recommendation in the previously cited guidance) would have confirmed that the practice was aware that the participant had undergone a screening intervention. Furthermore, development of a standardised referral method, for example, a prompt card or letter for pharmacy screened participants could ensure participants are appropriately followed up.

5.4.7 Key study findings in the context of the wider programme of work

The overall recruitment rate to the PRISM study presented in Chapter 4 (Figure 15) has been high. This correlates with the high level of acceptability and general positive experiences shared by pharmacists during the semi-structured interviews. However, recruitment rates did tend to vary between pharmacies with a small number of pharmacists finding recruitment particularly difficult. Views and experiences of the barriers to screening provide some explanation for the variation in recruitment rates. Barriers such as time, caused by varying staff levels between pharmacies and therefore ability to provide staff to cover the increased demand for appointments were an important factor. There was an anecdotal link between recruitment rate and the ability and willingness of the lead pharmacist to adapt the service to best suit the needs of the individual pharmacy. These adaptations in terms of how participants were invited to take part, together with how the screening was carried out have been described extensively in the results section of this chapter. Pharmacists who were willing to adapt the service to aid the implementation were those who were more likely to report better recruitment rates and this may be a significant factor in explaining the difference in recruitment rates between pharmacies during the PRISM study recruitment period. However, the low number of pharmacies
recruited to the PRISM study did not allow any quantitative analysis of this anecdotal link to provide more conclusive evidence.

Analysis of PRISM study data showed that following a screening appointment with a pharmacist 67.75% of participants identified as ‘high risk’ attended their GP for a confirmatory blood test as advised by the pharmacist. This rate of referral was in excess of what has been found in previous studies which have found that approximately 50% of high risk participants are followed up appropriately\(^\text{142}\). Further analysis of participant baseline questionnaire data found that neither illness beliefs relating to T2DM or self-perceived risk of T2DM had any effect on whether participants chose to attend their GP for a follow up appointment. The only factor which did have a significant effect on attendance was age. This was attributed to younger participants having less time to book and attend appointments due to full time employment. The qualitative findings relating to relationships between pharmacists and local GPs may give insight into some of the other barriers and facilitators of confirmatory testing uptake following a screening appointment. In particular, the lack of formal notice received from practices following a referral. Another barrier to collaboration was the distance between the pharmacy and the practice itself. In a number of cases where participants HbA1c results were very high (>12% / >107.7mmol/mol), the pharmacist physically accompanied the participant to the surgery reception if the pharmacy was located in the same building to ensure that practice staff were made aware of the participant’s blood test result.

Finally, the experiences of pharmacists presented in this chapter are useful in their detailed description of how each component of the screening was carried out. This included details such as: how participants were invited, which member of staff carried out each component of the screening, how results were discussed with participants and how pharmacists dealt with referring participants on to general practice for the appropriate follow up tests. This detail is often not recorded or presented in published evaluations of screening\(^\text{152}\), but is important in understanding how such a screening programme is implemented in a real world setting and can explain possible weaknesses in the screening methods chosen.
5.5 Chapter summary

This qualitative study of the views and experiences of pharmacists in the PRISM study showed that the screening methods used as part of the PRISM study were acceptable and feasible from pharmacists’ point of view but also identified ways in which pharmacists worked to improve the success of the screening by adapting processes to suit the needs of their pharmacies and patients. The relationship between community pharmacists and local GPs emerged as a further key factor in the success of pharmacy based screening.

The data collected highlighted both the multitude of roles adopted by community pharmacists when carrying out a screening for T2DM and the differences between individual pharmacies and pharmacists themselves when implementing screening services.

Giving autonomy to each lead-pharmacist to adapt services to suit the needs of both their pharmacy and their customers was seen as fundamental in the successful implementation of any screening service across such a diverse group of premises and pharmacists, and probably contributed to the high level of feasibility and acceptability reported by pharmacists.
Chapter six. Discussion: Summary, implications of the results and future recommendations.

6.1 Chapter overview:

This chapter summarises the main findings from the analysis of PRISM RCT data; the results are summarised and discussed in the context of what is already known on the topic. The quantitative and qualitative results are used to discuss implications current clinical practice and future research in the area.
6.2 Summary of findings

The total overall sample size required for the PRISM study is 2204. The number of participants recruited to date (n=1916) and included in this analysis is not sufficient to satisfy the original sample size calculation (recruitment currently 86.7% completed), therefore primary outcome data for both study arms is not yet available to present. Recruitment is continuing and it is anticipated that the study will recruit to target by December 2014.

For both study arms combined, 617 (32.5%) participants were identified as ‘high risk’ and referred for follow up. Follow up data was available for 493 (79.9%) of the participants referred. Follow up data showed that 334 (67.7%) attended a follow up appointment at their practice. Of the 159 who did not attend, 24 cases were due to a GP deeming the referral ‘not suitable’ and 29 were due to the participant not being registered with a GP. In 106 cases the reason for not attending the GP was not available. There was missing data on referral uptake for 124 participants (20.1%). Participants who attended a follow up appointment were more likely to be older than those who did not attend (p=0.008).

Data from follow up confirmatory testing at the participant’s surgery showed that 50 study participants (2.63%) were diagnosed with T2DM and 71 study participants (3.73%) were diagnosed as having IGR. A sensitivity analysis performed to calculate the total prevalence of T2DM and IGR yielded an estimated prevalence of 3.48% (2.70-4.40) for T2DM and 4.55% (3.63-5.60) for IGR.

6.3 Who attends pharmacist initiated screening?

The study participants included in this analysis were broadly representative of the local population in Leicester city in terms of ethnicity, with 49.6% of participants of WE ethnicity and 50.5% of participants from other ethnic groups. Previous study data has shown lower uptake of health screening amongst ethnic minority groups. The characteristics of the study population in terms of ethnicity would appear to contradict what has been reported in previous studies.
This may be explained by considering the demographic of the local population compared to national data. The WE population in Leicester city account for 45.1% of residents with 54.9% belonging to other ethnic groups. In particular there are a large number of residents who are of SA descent, making up 28.2% of the city’s residents. Data from the qualitative evaluation suggested that pharmacists had to utilise different skills when explaining results to participants from participants from some ethnic groups.

It is likely that the way in which healthcare services are delivered locally in the city has been adapted to meet the differing needs of this population. This could explain why ethnicity is not associated with underrepresentation in the study overall, or lower uptake of follow up testing in this study. Data from a previous inner city based UK study supports this hypothesis, showing that uptake of the NHS Health Checks was actually higher in SAs than WEs for a service implemented in a urban UK setting where 46.5% of participants were from other ethnic groups and 26.8% were of SA ethnicity. The authors of this study hypothesised that ethnicity of HCPs was reflective of the local population and this ‘cultural concordance’ between patients and physicians, known to improve patient satisfaction, resulted in increased uptake to a screening invitation amongst participants from a variety of ethnic groups. The characteristics of pharmacy staff taking part in the qualitative evaluation of the PRISM study showed that 75% of pharmacy staff were of SA ethnicity (Chapter 6, Table 8). Data from the qualitative evaluation suggested that the majority of pharmacists felt that they had the necessary skills to provide the service to participants from a variety of ethnic groups. In many cases, the pharmacists themselves belonged to the same ethnic group as the participants they recruited to the study. This shared culture was seen as important when engaging with participants by pharmacists.

Analysis of recruitment rates to the study showed higher recruitment of females than males (61.4% and 38.6% of the study sample respectively). Lower uptake rates to screening among males have been reported in previous screening studies for T2DM. Results from the systematic review and meta-analysis presented in Chapter 2 show that of the study population included in the
analysis, 43.4% were male. Males attributed for more than 50% of the study cohort in only two of the sixteen papers included in the meta-analysis\textsuperscript{142}.

The majority of studies assessing screening uptake for lifestyle related diseases such as T2DM do report higher rates of recruitment for women\textsuperscript{142} but the factors that influence this difference are unclear. Previous literature has suggested that the difference in gender uptake is reflective of a traditionally held belief that females have a higher likelihood of engaging with HCPs than males \textsuperscript{158}. However these differences are largely explained by the increased number of consultations pre and post-pregnancy and related to care and responsibility for children. Rates of consultation for males and females with HCPs regarding serious health issues where symptoms are present are more comparable \textsuperscript{159}. It is possible that there could be congruence between factors affecting confirmatory testing attendance generally and factors affecting initial screening attendance.

Many of these factors affecting uptake may be also be disease specific and not generalisable between conditions\textsuperscript{160}. For example, the reasons reported for non-uptake of other routinely offered health screening tests offered to men could be different to reasons for male non-attendance to T2DM screening. It is likely that there are more generalisable logistical factors such as employment status which could play a role in attendance to screening generally, with one possible application of this hypothesis being that the female majority employed in part time positions or with childcare commitments may have more flexibility to attend a screening appointment. Alternately, the results of the current study, with regards to the gender mix of participants, may be reflective of a more general trend of increased use of primary care services by females when compared to males\textsuperscript{161,162}.

During screening for the PRISM study, participants’ GP registration status was not recorded at the time of screening. Data was only available on participants who were advised to visit a practice to register and request a follow up test. Recent data from the CVD screening programme in Leicester city showed that 8% of participants undergoing CVD screening at a pharmacy were not registered with a GP\textsuperscript{129}. No comparable data was collected during the PRISM
study. However, it was known that of the 493 referred participants for whom follow up data was available, 29 (5.88%) did not register at their local practice as advised by the pharmacist. Data from the PRISM study does show that there were a significant number of participants who were not registered with a GP at the time of screening. This, in itself, could be considered a positive outcome as these participants would be unable to engage with practice based screening services.

6.4 Comparison of the study findings with existing literature

When considering the results of the study, it is important to differentiate between initial uptake of screening and uptake of confirmatory testing in participants who are identified as high risk. Maximising uptake of confirmatory testing is essential to ensure maximum efficacy of a screening intervention. Method of invitation\textsuperscript{163}, type of advice and education given as well as practical considerations such as time and location of screening can all be tailored to suit the needs of individual patients to promote higher uptake\textsuperscript{164}. However, maximising uptake to an opportunistic screening programme such as the PRISM study may not in itself be desirable. A more realistic goal may be to ensure a patients screening decision is based on relevant and sound information and the decision made reflects the decision makers’ values\textsuperscript{165}. Previous research has found that informed choice to take part in screening is associated with willingness to accept subsequent lifestyle advice\textsuperscript{166}. Similar factors could be associated with higher uptake to confirmatory testing following a positive screening result. Opportunistic screening has previously demonstrated efficacy over and above that of an organised screening approach in identifying participants with high cholesterol and hypertension, despite lower levels of uptake to the initial screening invite (59% organised screening vs 15% opportunistic screening)\textsuperscript{167}.

Participants recruited to this study had a higher risk of T2DM when compared to a recently published evaluation of screening for T2DM in a large cohort by a nationally recognised high-street pharmacy chain\textsuperscript{168}. This study used a similar screening method to what was used in the risk score arm of the PRISM study, whereby participants filled out a copy of the LSA risk score and were referred.
for confirmatory testing if their score was ≥16. In this study 29.1% of participants had a score ≥16 compared to 56.7% of participants recruited to the PRISM study. This difference was largely attributable to a significantly higher proportion of participants from ‘other ethnic groups’ recruited (13.5% and 50.5%) and, to a lesser extent, waist size, BMI and family history of diabetes.

PRISM study referral data showed that following a screening appointment with a pharmacist, 184 (19.09%) participants in the risk score + NPT arm and 433(46.21%) participants in the risk score arm were referred to their practice for a follow up blood test. Comparison with other studies focussing on rates of referral to a confirmatory test is difficult for a number of reasons: Firstly, referral criteria differ significantly between studies. Criteria for referral are based on a variety of different blood tests which do not necessarily have a high level of agreement. Secondly, underlying prevalence varies both within and between countries. When using the same cut-off points for referral to confirmatory testing when screening for T2DM, the number of participants referred would be affected by the prevalence of the condition in the area which screening is taking place. For example, prevalence of T2DM in the United States (US) is almost twice that of some European countries. Lastly, comparison of referral rates over time even using the same criteria is difficult due to the rising prevalence of T2DM worldwide.

The only comparable rate for a pharmacy initiated screening study in the UK found that 3% of participants screened were referred to their practice for follow up. Due to the fact that there was no clear guidance on cut-off point for random blood glucose (RBG) as a screening tool for T2DM, the authors of this study used a cut-off point for referral of <4mmol/l or >10mmol/l. There is no current guidance on cut-off point for RGB to screen for T2DM, however a value within the range of 5.5-6.7mmol/l is thought to discriminate best as a cut-off point for T2DM. The RBG test taken in the cited study was part of a larger battery of tests primarily designed primarily to detect participants with a high CVD risk. The relatively high RBG referral cut-off point may explain the low number of participants who were referred specifically for a follow up confirmatory test for T2DM.
PRISM study data was available for 493 of the 617 participants (79.9%) referred to their practice for follow up. Of the 493 participants with complete follow up data, 334 (67.75%) were known to have attended their GP for a confirmatory test. There is a lack of studies providing reliable comparable data on participants referred to their GP for follow up\textsuperscript{152}. This is due to both poor methods of measurement and incomplete measurement of the population screened. Typically pharmacy based screening studies provide follow up data for less than 50% of the population referred\textsuperscript{102,129,142}, which is problematic due to the increased risk of bias. This risk of bias is also heightened by the data collection methods used to collect this outcome data. The ‘gold standard’ method of data collection for uptake of a confirmatory test would be by direct extraction from participant medical records held at the GP practice. However, this is a difficult method to use in practice as it involves a researcher having to visit each practice in person to complete the data collection. The majority of studies included in the meta-analysis (chapter 2) which measured uptake of confirmatory testing as an outcome, did so by sending questionnaires to be filled out by either the practice or the patient. Return rates for these questionnaires tend to be very low\textsuperscript{110}. Practices that receive a low number of referrals or do not follow up a referral from pharmacy may be less likely to return a request for follow up data, therefore giving an inaccurate measure of attendance rates following a screening test.

The rate of attendance to confirmatory testing in the PRISM study (67.8%) is in excess of what is typically reported by the limited number of comparable studies. For example, Krass et al\textsuperscript{102} reported attendance rates of 76% which at first would seem more successful than the PRISM study. However closer scrutiny of this paper showed that 49% of participants who were identified as high risk declined a referral. It would be more appropriate to group these participants with those who chose not to attend the GP appointment which would have the effect of reducing the rate at which participants attended their practice for follow up to 29.33%. The only other comparable study reported a 74.9% attendance rate. However this was measured using a postal questionnaire sent to the practice with questionnaires returned by the practice.
for only 12.8% of the participants referred\textsuperscript{110}. Such a low level of data returned leaves the results of this particular study open to bias.

Further analysis of PRISM study follow up data showed that participants who attended their practice were older than those who did not. This is typical of the findings of other pharmacy initiated screening studies\textsuperscript{174,175}. Establishing causality for the difference in uptake between younger and older participants is difficult. Previous pharmacy based studies have not analysed follow up data to control for other confounding factors known to affect follow up attendance to GP based screening studies such as GP list size and medication history\textsuperscript{120}. One previous study found that a history of antihypertensive medication was a significant factor affecting initial screening attendance and confirmatory testing uptake\textsuperscript{155}. Antihypertensive use is more common amongst older participants and could contribute to the difference in uptake of confirmatory testing. This finding is in agreement with a more general trend of more frequent attendance to consultations at general practice among older people\textsuperscript{176}. In addition to this, older participants are more likely to be retired and able to attend follow up appointments during the day.

Following confirmatory testing at the practice, 50 study participants (2.63\%) were confirmed as having T2DM and 71 study participants (3.73\%) were confirmed as having IGR. To estimate the prevalence of T2DM and IGR in the total population screened, rates of diagnosis from participants with follow up data available were inflated to account for the small percentage participants with no follow up data. This analysis yielded rates of 3.5\% and 4.6\% for T2DM and IGR respectively.

Comparison of screening yields between similar studies would be of limited use in evaluating the relative effectiveness of the screening methods used. This is due to differences in both the true prevalence rates of T2DM in the population being screened and changes in these rates over time. It may be more appropriate to consider the screening yield compared to the estimated prevalence rate for undiagnosed T2DM in the same geographical location from which the study recruited the participants. For example, in Leicester city the estimated prevalence rate for undiagnosed T2DM is 3.1\%\textsuperscript{177}. The screening
yield of 3.5% would therefore suggest that the screening methods used are effective in correctly identifying a significant proportion of participants recruited to the study with undiagnosed T2DM.

The PRISM study was successful in identifying a high number of participants with T2DM. However, the yield for IGR, although still a significant figure was lower than what would be expected in the local population. There are no local estimates for the prevalence of IGR but the most recent national estimates for prevalence are between 15%-20%\(^\text{178}\). These rates were obtained from a primary care based screening study over a decade ago and were made according to previous WHO diagnostic criteria based on OGTTs or FBG tests and not HbA1c.

The reasons for the discrepancy between national estimates for prevalence of IGR and the screening yield for IGR reported in this study are unclear. One hypothesis is that the coverage of screening for T2DM in the locality of the study is such that the majority of people with impaired glycaemic control are picked up by screening programmes already provided by their GP. The rate of uptake to NHS health checks in Leicester city compares well to rates nationally which would suggest that GP based screening in the local area is well organised and achieves good levels of coverage when compared to the rest of the UK\(^\text{179}\). It may be possible that participants identified with T2DM by pharmacy based screening may be those less likely to engage with GPs. It is only by offering community based screening to such participants that T2DM has been identified at a later stage than had they engaged with practice based screening programmes such as NHS health checks which could explain the relative low yield of IGR and high yield of T2DM detected during the PRISM study.

There were 33 participants who attended their practice for a confirmatory test who received both a FPG and HbA1c test at the first appointment. 8 of these participants (22.2%) had a HbA1c or glucose reading in the ‘diabetes range’ and should have received a second test to confirm diagnosis according to NICE guidance\(^\text{116}\). However the result of the other test was below the threshold for T2DM and they did not have a record of having attended the GP for any follow
up test. Due to the way in which this approach was recorded on the GP system it is unclear as to why guidance on diagnosis was not followed. It is possible that the GP responsible for the participant may have not had knowledge of the most recent diagnostic guidance. It is not recommended that the two different tests are used in conjunction to diagnose T2DM as they are known to identify distinctly different groups of people\textsuperscript{180} which increases the likelihood of patients with undiagnosed T2DM having a false negative screening result.

Previous T2DM screening studies have shown that participants often have a relatively low understanding and inaccurate perceptions of their own risk of T2DM. For example 44% of participants recruited to a large European study could not give any estimate of their risk of T2DM. In addition to this, 31% of participants from the same study perceived their risk of being diagnosed with diabetes as 0%\textsuperscript{181}. PRISM study data showed that, at baseline only 16% of participants were unable to give an estimation of their absolute risk of being diagnosed within their lifetime and only 3.47% of participants perceived their absolute risk to be 0%. This discrepancy in results could be attributed to a number of different factors. It is possible that the period of time between the PRISM study and the previously cited study may have been a significant factor. The prevalence of diabetes has risen dramatically in the previous decade\textsuperscript{4}, which has attracted increasing mainstream media coverage and attention. Public knowledge of T2DM and its risk factors could have increased as a result of this publicity leading to improved awareness and more accurate predictions of one’s own risk, evidenced by the questionnaire data reported in the current study.

6.5 Strengths and limitations of the overall programme of work

6.5.1 Strengths

One of the strengths of this programme of work is evident from the novel yet robust methods utilised. Firstly, a systematic review and meta-analysis was carried out using evidence based methods of critically appraising the findings of pertinent literature\textsuperscript{96}. The evidence from this systematic review has highlighted
areas of weakness in previous literature; including incomplete follow up of participants found to be at risk. This review has provided rationale and informed the design and conduct of the RCT carried out during the programme of work.

The PRISM study has provided data from a ‘real world’ evaluation of two previously validated screening tools for T2DM and has contributed to addressing the gaps in literature highlighted by the systematic review. In particular, the study has provided data to inform a cost effectiveness analysis of the screening methods used which was identified as a major weakness in the literature.

To my knowledge, this is the first evaluation of this type of method of screening for T2DM within a community pharmacy setting in the UK. It is also the largest study of this nature to date. The data on screening yield and uptake to confirmatory testing was available for almost 80% of the participants referred. This degree of follow up data collection from patient records held at general practices has not been achieved previously following pharmacy initiated screening studies for T2DM in such a large study cohort. These findings will provide the opportunity to perform a comprehensive cost effectiveness analysis of pharmacy initiated screening for T2DM.

Finally, in addition to the robust quantitative research methods employed in carrying out the RCT, the use of qualitative methods allowed a more informed interpretation of both qualitative and quantitative results. For example, although the rate of uptake to confirmatory testing was higher than rates reported in previous screening evaluations, the level of non-attendance was still significant. During analysis of the data from the qualitative evaluation a theme emerged relating to local pharmacists’ experiences of collaborative working with local GPs. A number of barriers to collaborative working were reported, including geographical distance between the pharmacy and surgery and referral pathways between the pharmacy and practice staff. Solving this issue could overcome a significant barrier to non-attendance to confirmatory testing. The level of drop out may be a reflection of a failure to follow previously published guidance on collaborative working between pharmacists and GPs, and one way
in which future screening and referral methods can be refined to improve the efficacy of future interventions of this nature.

6.5.2 Limitations

It is acknowledged that the study findings presented in Chapter 4 may be limited by some methodological weaknesses, and in particular, with the screening tools used and the methods of analysis which were employed. One of the major weaknesses with this analysis is that the number of participants recruited has not yet satisfied the sample size calculation set out in the original study methodology. As a result of this I was not able to compare primary outcome data between study arms as specified in the research objectives (chapter 3). The rate of recruitment was lower than anticipated. Estimates of recruitment rate were based on a previous CVD screening pilot carried out in community pharmacies in the local area which screened a similar number of study participants as the proposed sample size for the PRISM study over an 18 month period\textsuperscript{129}. It was initially envisaged that appointment times for the two studies would be similar. In practice however, appointment times were longer for the PRISM study due to the consent procedure and questionnaire used. Results from the qualitative evaluation presented in Chapter 5 revealed that many of the participating pharmacies have been under increasing financial pressures in recent years due to reductions in NHS funding. This has resulted in a reduction in the number of pharmacy staff and added to the issue of increased demand for screening appointments.

When considering the demographics of the pharmacy staff and characteristics of the pharmacies participating in the study, it is possible that such a small sample may not be generalisable to pharmacies nationally. Pharmacies in the UK vary dramatically in terms of management structure (independent pharmacies vs chain pharmacies) which places limits on the degree to which pharmacists can decide on which services they provide and how their delivery is organised. The qualitative evaluation provided good insight into how the screening was implemented in each of the pharmacies including barriers and facilitators of recruiting study participants. However, due to the differences
between both pharmacy staff and the pharmacy itself, these insights were often specific to the pharmacy taking part and may not apply to a larger national sample of pharmacies or pharmacy staff. A more extensive evaluation of the way in which a nationally commissioned service is implemented may be necessary to capture a more representative sample of pharmacy staff. In spite of this, many of the qualitative findings relating to barriers and facilitators were similar to what has previously been reported in the limited number of qualitative studies evaluating the implementation of pharmacy based screening studies 145.

Although the demographic of study participants in terms of ethnicity is representative of the population in the locality, this is not representative of the population nationally 153. It is possible that the high screening yield found in this study is partly attributable to the high number of participants from BME groups, a population that is known to have higher prevalence rates for T2DM 183. It is logical to suggest that in areas of the UK where T2DM is less prevalent, screening yield from population screening services would be lower. The associated screening costs per case detected would therefore be higher.

The primary outcome of the PRISM study was rate of uptake to confirmatory testing. Uptake to an initial screening test is influenced by a variety of logistical and psychological factors. When assessing uptake to screening it is necessary to consider the effect of assessing this outcome within a research study environment. When recruiting to this study some risk of response bias was unavoidable as participants had the choice to either accept or decline the screening invitation. In the qualitative evaluation, pharmacists reported that some participants were apprehensive when filling in data collection forms and signing consent forms. To assess the degree to which response bias may have occurred it would have been preferable to have collected data on all participants invited to take part in the screening and compare data between those and who did not agree to take part in screening. While it was not possible to conduct this type of data collection in a pragmatic study of this scale, it may be possible to conduct some type of validation of the data collected by comparison with audit data on commissioned T2DM screening services taking place in community pharmacies. Although this would not allow assessment of response bias to screening, it may validate the results of evaluations of
research studies focussing on screening by comparing participant characteristics from commissioned screening services to participants screened as part of research studies. Comparison of previous uptake data between locally conducted NHS Health Checks\textsuperscript{184} and a local large scale GP based screening study for T2DM\textsuperscript{157} shows that uptake to the latter research study is substantially lower than a commissioned GP based NHS Health Check service (22.0\% and 51.6\%). Response rate to a screening invite must be considered when interpreting the results of the screening intervention as a low response rate may indicate a low level of participant acceptability of the screening being offered and would also increase the risk of response bias.

In spite of this weakness the results of the PRISM study show that both uptake to confirmatory testing and screening yield compare favourably with the findings of a previous evaluation of pharmacy initiated screening for T2DM\textsuperscript{110}. If such a service were to be commissioned in pharmacies, the process of completing informed consent procedures and filling out baseline questionnaires and data collection forms would not be necessary. This would make the length of appointment significantly shorter which would be preferable to both pharmacists and participants alike. Data from interviews with pharmacists showed time as the greatest limiting factor to participant recruitment which would suggest that if such a service was implemented outside a research setting it would achieve a level of participant and pharmacist acceptability in excess of what was reported in the evaluation of this study. From a participant perspective, rate of initial screening uptake would likely be in excess of what was reported in this analysis due to shorter screening appointments which would reduce the time pressure on the pharmacists and improve the convenience to the participant to overcome some of the barriers to screening reported in the qualitative evaluation (Chapter 5).

One final weakness of the PRISM RCT related to the LSA risk score tool that was used. Pharmacist feedback relating to the acceptability of both screening tools chosen for use in the PRISM study was positive. The LSA risk score was especially useful to pharmacists in informing discussion regarding risk and the effects of both modifiable and non-modifiable risk factors on T2DM risk. The LSA risk score algorithm used to calculate the score was developed almost 6
years ago and was originally developed to identify those with undiagnosed T2DM based on the outcome of an OGTT\(^3\). Since then, the diagnostic criteria for T2DM have changed, with the majority of diagnoses now made by measurement of HbA1c\(^3\). This change in diagnostic criteria has implications associated with the accuracy of the LSA risk score in assessing risk of T2DM. To address this, further analysis is underway within my department to refine and validate the LSA risk score using HbA1c as an outcome to classify T2DM.

**6.6 Summary of the implications for clinical practice and public health**

The results of the systematic review and meta-analysis presented in chapter 2 showed that there is a lack of research in the area of pharmacy based screening for CVD risk factors, as evidenced by the small number of trials identified by the systematic literature search (n=16). Analysis of data showing number of participants with a positive screening result indicates that screening in community pharmacies is feasible and results in a significant number of individuals being identified who may benefit from intervention to lower their risk of developing CVD. The analysis also suggests that a high number of these individuals do not attend their practice to confirm a diagnosis. However, interpretation of these results is difficult due to incomplete collection of follow up data.

Due to the methodological weaknesses in the screening interventions in this area that have been carried out, it could be argued that feasibility of community pharmacies as sites for screening has not yet been established. More robust evaluation of pilot screening interventions including analysis of cost effectiveness may be required prior to considering further investment into pharmacy based screening for CVD risk factors.

The quantitative results of this study are extremely relevant to providers and planners of screening services and have a number of implications on the delivery of screening interventions both currently and in the future. The results provide more conclusive evidence than existing studies. The screening resulted in a high yield of participants diagnosed with T2DM who will benefit from
interventions to reduce their risk of microvascular and macrovascular complications. The screening also identified a significant number of participants with a high risk of T2DM who would benefit from intervention to reduce their future risk of T2DM\textsuperscript{185}. The screening yield for both T2DM and IGR compares favourably with previous pharmacy based screening studies in the UK\textsuperscript{109}, other healthcare settings such as GP practices, as well as with the most recent estimated prevalence rate for T2DM and IGR in the local area \textsuperscript{177}. The results of this study add strength to the findings from the earlier systematic review that pharmacy based screening is effective in identifying high numbers of people with T2DM and IGR whom would benefit from management of their condition or risk of T2DM in the future. A planned cost-effectiveness analysis informed by the results of this study will provide data on cost per case detected and number needed to screen. This will provide directly comparable data with screening for T2DM at other sites (both within a community and traditional healthcare setting).

This study was successful in recruiting a representative sample in terms of ethnicity when compared to the local population. This is atypical of screening interventions offered which tend to under-recruit participants from ethnic minority groups. As discussed earlier, the demography of the population in the local area of Leicester shows a far higher number of residents from BME groups compared to other parts of the UK. Healthcare delivery had adapted to suit the needs of the now majority BME population. Characteristics of the pharmacists taking part in the qualitative study show that this is reflected in the ethnicity of pharmacists working in Leicester city and this ‘cultural concordance’ may promote the delivery of culturally suitable health advice and services.

In contrast to the successful recruitment of high numbers of participants from BME groups, the PRISM study recruited lower numbers of males (42.95\%) than females (57.05\%). This is in agreement with the findings of previous screening studies\textsuperscript{142}. This evidence would support either an individually tailored approach to screening invitations to attract a higher number of males to screening. An alternative approach would be similar to that adopted by Horgan et al\textsuperscript{109} who utilised a male targeted advertising campaign to attract men to an opportunistic CVD screening programme. This study was highly successful in increasing
uptake of males and recruited a male majority (60%) to the study. In the short term recruiting a male majority may be beneficial in addressing the inequality in screening currently reported in screening studies for T2DM and CVD risk factors. However in the longer term, in order to ensure that populations screened are representative of the population in general, screening interventions may need to be accompanied by male targeted recruitment methods to ensure the screened population is balanced in terms of gender.

The results of this study do demonstrate that community pharmacists are well embedded within the local community, and therefore have the ability to offer screening to participants who may not be registered with a GP or may be less likely to accept an invitation to practice based screening. Evidence from the implementation of NHS Health Checks shows that in many regions of the UK, only modest rates of uptake to Health Check invitations have been achieved. Community pharmacists could therefore be ideally placed to support the delivery of some aspects of the NHS health check, such as T2DM screening.

Of the 159 referred participants who did not attend their practice, 24 participants did not attend due to their GP deeming the referral unnecessary. In the majority of cases this was due to the participant already having undergone a fasting test for T2DM within the previous 12 months. Although a relatively small percentage, this does represent a duplication of effort by pharmacists repeating tests unnecessarily. This highlights one difficulty in providing pharmacy services which are already being offered by general practices. In particular, due to the lack of electronic data linkage (previously cited as a barrier to NHS Health Checks), knowledge of a recent screening result is entirely due to participant recall. In the current study, the number of participants who were referred unnecessarily suggests that participant recall has proved unreliable. If investment is to be made in pharmacy screening it may be necessary put more robust measures into place to ensure that this duplication of effort is avoided.

The results of the qualitative evaluation shed further light on the possible facilitators of incomplete follow up of referred patients. The level of collaboration between pharmacists and local GPs is generally perceived as good from the
point of view of pharmacists taking part in the PRISM study. There were however areas that were identified as having potential for improvement, including improved communication and acknowledgment of referrals from pharmacists. Through better adherence to published guidance for both pharmacists and GPs \(^{151}\), it may be possible to encourage follow up of participants requiring confirmatory testing from a GP or nurse at their practice following a pharmacy referral.

Further analysis of predictors of attendance to confirmatory testing following an abnormal risk screening result showed that age was the only characteristic significantly associated with higher uptake of confirmatory testing. The possible reasons for the lack of other significant differences between attenders and non-attenders are unclear. One possible explanation is that due to the nature of the stepwise screening design, the number of participants that attended their practice for follow up testing was relatively low, therefore, detecting small differences between the two groups may have not been possible.

One alternative explanation is that attendance to follow up during the PRISM study may have been governed in the majority of cases, by the practice initiating the test rather the participant, however analysis of HbA1c data between those who did and did not attend showed no difference in HbA1c between the two groups. It may be expected that practices would be more likely to initiate follow up of participants with an abnormal HbA1c result due to the clinical implications of high HbA1c, which was found not to be the case during this study.

In addition to providing possible barriers to follow up of referred participants, the qualitative evaluation emphasised the fact that public health interventions in community pharmacies, whilst utilising evidence based screening and risk communication tools, need to have built in flexibility for pharmacies to implement services in a way that suits both the pharmacy and their customer base.

In addition to this, the results of the qualitative interviews provided insight into the multitude of roles pharmacists have in delivering public health services in addition to the important role other pharmacy staff (including technicians) have
in the delivery of these services. Previous research has described feelings of apprehension of this expanding role of pharmacists from both GPs and patients\textsuperscript{141}. Despite this, pharmacists are often the first port of call for many people from high risk groups who do not regularly attend a GP. Future training of pharmacists should reflect this. Effective risk communication informed by a patient centred approach when giving results and advice were key skills that were reported to not be sufficiently addressed during training for early career pharmacists.

6.7 Summary of the future research implications

The present research provides evidence that pharmacy initiated screening is feasible and could increase uptake to health screening, particularly in groups who do not access GP based screening or are not registered with a GP. However data from the limited number of studies in this area shows that the efficacy of a preliminary screening intervention in achieving high screening yields for CVD risk factors may be limited by high rates of drop out to confirmatory testing. Evaluations of community based stepwise screening strategies, where the risk of drop out is high, need to measure uptake more accurately to allow a more thorough evaluation of the screening method. When developing and evaluating screening interventions thought must be given to ways in which to increase not only uptake to the initial screening, but also uptake to the confirmatory testing by individuals identified as high risk.

At the time of writing this thesis, the PRISM study has not recruited to target and as a result, between study arm difference in the primary outcome has not been analysed and included in the results. I was however, able to analyse characteristics of participants attending and not attending follow up testing. The results showed that age was the only characteristic showing a significant difference between those that did attend and those that did not. Further research is required to establish whether there are other factors which predict which participants are more likely to attend follow up testing. With this information, the educational advice and test results could be tailored to ensure
that those identified as high risk are followed up appropriately. This would ensure maximum efficacy and yield of the screening intervention.

The presented quantitative data on uptake and screening yield will be used to conduct a robust cost effectiveness analysis of pharmacy initiated screening in the UK. The results may encourage further investment, to allow pharmacists to play a greater role in screening for CVD risk factors in the future.

The results of the qualitative analysis of interview data have provided some explanation for a number of the key findings from the quantitative evaluation. In addition they provide an insight into the practicalities of carrying out a pragmatic RCT within a pharmacy setting and of working with pharmacists in research experience. Due to practical and financial limitations of the study, participants were randomised at the individual level. This caused some problems when recruiting using opportunistic methods. ‘Word of mouth’ was successful in increasing uptake to the screening in a number of the pharmacies, and in some cases was actively encouraged by participating pharmacists. However, this brought about an unexpected negative consequence of perceptions of what the screening test involved when recruiting new participants. As described in chapter 4, some participants expressed a sense of disappointment at not receiving an HbA1c test as part of the screening. It may be advisable in the planning of future research using opportunistic screening interventions, to consider using cluster randomisation at the pharmacy level. Although this would increase the sample size needed to detect between group differences in outcomes, choosing this method of randomisation may increase the ease and speed of recruitment and improve the participants understanding of what the screening would involve as each pharmacy would be offering one screening pathway instead of two separate pathways within the same pharmacy.

From a pharmacist’s point of view, as evidenced in the qualitative interview data, a number of pharmacists spoke of the urge to ‘cherry pick’ participants they perceived to have the highest risk of T2DM based on visible risk factors (ethnicity, waist size, age etc). This approach by pharmacists is consistent with their normal practice and desire to provide services to those that they perceive would derive the greatest benefit. However, this is in contrast to the
fundamentals of research practice and this conflict of interest has the potential to cause difficulties in future research with research naïve HCPs. Pharmacists were advised that this practice was against the study procedures and would resulted in biased results. The balanced study group size suggest that in fact this bias had not occurred but the experiences and feelings shared by pharmacists in the qualitative evaluation merit further consideration of cluster randomisation at a pharmacy level in future RCTs to eliminate the risk of bias in the evaluation of screening interventions.

The immediate task following the completion of my PhD is to complete the recruitment, analysis, write up and publication of the PRISM study follow up data in high impact peer reviewed journals. The precise application and future direction of research in the area will be dependent on the results of this analysis. However, the preliminary analysis of data for this PhD does strongly suggest that a high screening yield for T2DM and IGR can be achieved by screening in community pharmacies and the method is feasible and acceptable from pharmacists’ point of view.

In the short term, the robust data already collected on rate of uptake to confirmatory testing and screening yield will be used to inform a cost effectiveness analysis. Cost effectiveness analyses are lacking in this area and publication and dissemination of this work will contribute greatly to addressing this gap in the literature. This data will allow direct comparison with using other screening methods in both general practices and community sites such as community and faith centres.

The results of the study highlight the potential for screening in this area. However, certain failings within the screening process were exposed and future research is required. Firstly, there is the potential to maximise the uptake to confirmatory testing further by exploring and evaluating different referral methods between pharmacists and GPs with the aim of implementing a more robust and standardised method. Secondly, the screening tools used during the study may benefit from further refinement and piloting. For example, developing the LSA risk score for use in populations with a high number of participants.
from BME groups. This would include adaption of the algorithm used in calculating the LSA risk score and presentation of the results and advice.

Previous studies have shown that a significant number of pharmacists report low levels of confidence in the delivery of pharmacy services aligned to health promotion such as smoking cessation \(^{188}\) although the qualitative data presented in Chapter 5 does appear to contradict this. Nonetheless, in the longer term there is scope for the development of enhanced training and education to improve the ability of pharmacists to deliver health advice.

6.8 Concluding remarks

In conclusion, this programme of research has made a significant contribution to addressing gaps in the literature relating to the evaluation of pharmacy initiated screening for T2DM. More specifically, the systematic review and meta-analysis provides a summary of previous levels of success of pharmacy initiated screening including flaws in the methods used in previous evaluations. Analysis and presentation of the initial findings from the PRISM study provides evidence for the feasibility of community pharmacies as screening sites for T2DM. The data produced will be of great value in providing a cost effectiveness analysis of this method of screening in the future. The qualitative evaluation has provided great insight into the barriers and facilitators of recruitment to screening within a pharmacy setting. The qualitative data also provides a summary of the variety of roles played and competencies required by community pharmacists when providing screening services to the local population.
Appendices. Supplementary material

Appendix 1. Supplementary material relating to the systematic review and meta-analysis of the effectiveness of pharmacy initiated screening for CVD risk factors.

Appendix 2. Supplementary material relating to the PRISM study quantitative analysis

Appendix 3. Supplementary material relating to the qualitative evaluation of feasibility and acceptability of the screening methods used during the PRISM study.

Appendix 4. Copies of published manuscripts
Appendix 1. Supplementary material relating to the systematic review and meta-analysis

Appendix 1.1 Review protocol
Appendix 1.2 Search strategy
Appendix 1.3 Quality rating criteria checklist
Appendix 1.4 Data extraction form
Appendix 1.5 Statistical analysis output
1.1 Review protocol

Pharmacy based screening

Prevalence of lifestyle related diseases such as cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM) in the UK have seen a significant upwards trend in recent years\textsuperscript{170}. Although these two diseases are unique they share a number of the same risk factors such as obesity, hypertension, hyperlipidaemia and age. Diabetes currently affects 6.8\% of the population in the UK and it is estimated that the upward trend in prevalence will continue and by 2030 7.5\% of the population will be living with diabetes\textsuperscript{170}. T2DM is usually characterised by a slow progression from normal glucose control to IGR before becoming sufficiently impaired to be diagnosed as diabetes. Often individuals are diagnosed with T2DM in primary care after attending for a complication of diabetes such as CVD as individuals with IGR suffer extremely mild, if any symptoms which may not be picked up during routine general practice\textsuperscript{189}. As a result of this the prevalence of undiagnosed diabetes in the UK stands at 1.5\% for women 3.1\% for men\textsuperscript{190}. This prevalence data suggests that there is scope in the UK to improve screening services for diabetes to ensure that both individuals at high risk are identified in order to delay or prevent the onset of diabetes, and to ensure individuals with diabetes are receiving medication which will reduce the risk of further complications. Recent economic evaluation from the US and UK focussing on screening for T2DM and IGR in adults concluded that from an economical perspective screening and preventative management in high risk patients was more cost effective in the long term\textsuperscript{191,192}.

The prevalence of CVD in England currently stands at 10.9\% for those aged 54 to 64 rising to 44.4\% in people over the age of 75\textsuperscript{95}. Like T2DM, the early detection and treatment of modifiable risk factors has great potential to reduce the burden of CVD.

Due to the high levels of undiagnosed T2DM and CVD in the UK the NHS recently introduced a national screening programme for diabetes, CVD, Stroke and kidney disease. This programme was aimed at individuals aged 40-75 years with individuals being screened every 5 years. It was anticipated that this would lead to an extra 330 appointments per year in practices with a list size of 5600. This does not take into account additional demand for follow up appointments with either a GP or nurse. The DoH estimate that 20\% of people screened will require a statin\textsuperscript{193} and/or
antihypertensive medication which will require further ongoing follow up for optimisation of treatment and demand for appointments. In 2010 the DoHs white paper entitled ‘Equity and Excellence: Liberating the NHS’ announced plans to shift more responsibility to GPs to control their own budgets and to choose which services they provide through the formation of local GP ‘consortia’. The increased pressure from budget planning and extra demand will place significantly more pressure on GPs time.

Original guidance documentation from the DoH relating to the NHS ‘Health Checks’ programme makes it clear that health checks can be completed by any health care professional provided they have had the relevant training. This suggests that there is scope for other HCPs to support the ‘Health Checks’ programme to reduce the pressure on GPs due to an increased number of appointments. There are a number of ways in which other HCPs could support screening programmes for T2DM and CVD, one of which is the integration of local community pharmacies.

A recent review described pharmacists as knowledgeable specialists who are currently seen as an underused resource within the primary care health team. However, pharmacists are already involved in the management of diabetes and their involvement has shown beneficial effects in patient education and disease management in the UK. Previous evaluation of a recent pharmacy based screening programme for CVD in Leicester showed that such a service is popular with both pharmacists and participants due to the informal nature of a screening appointment compared to screening in general practice and the opportunistic nature of the screening and not having to book an appointment to see a health care professional. The integration of community pharmacists into the primary care team particularly with regards to screening for T2DM and CVD has advantages beyond the increased acceptability to the patient. Two recent UK pharmacy based screening programmes found that 7-8% of the total population screened were not currently registered with a GP. This is one flaw with GP based screening programmes in that they cannot capture that population that is not registered on a practice list which is resolved through the better integration of community pharmacists into the primary care team.
There have been only a small number of previous trials of pharmacy based screening for T2DM or CVD in the UK or worldwide. Of those trials that do exist the number of patients who attend the GP for a confirmatory test following a pharmacy referral is typically below 50%\textsuperscript{200}. There is therefore, a great deal of scope for further development of screening interventions to increase uptake of pharmacy referrals in participants at high risk from T2DM and CVD, particularly by up skilling pharmacists to increase the quality of the interaction between patient and pharmacist to increase effective risk communication.

The purpose of this systematic review will be to collate and evaluate current literature focussing on pharmacy based screening interventions for T2DM and CVD.

**Methods**

**Search methods for the identification of studies**

**Types of Studies**

All study types will be included in this review. No language restrictions will be imposed.

**Participants**

Individuals without a previous diagnosis of diabetes or CVD and aged 40 and above will be included in this review.

**Types of screening Intervention**

Opportunistic pharmacy based screening interventions will be included in this review. Screening interventions will be defined as pharmacy based if the initial appointment is conducted at the pharmacy even if a diagnosis of diabetes is made at general practice or hospital. Screening interventions for diabetes which use random blood glucose, HbA1c test, fasting blood glucose or OGTT individually or in combination will be eligible for inclusion. Screening tests that include assessment of blood pressure or lipids for CVD screening will be included. Screening interventions which use a stepwise method with an initial questionnaire type assessment followed by a
blood test will be included provided the initial appointment is conducted by a pharmacist.

Types of outcome measures

Main outcomes

The primary outcome measure for the study will be percentage of individuals who are referred to their GP following a screening test and the percentage who take up a referral from their pharmacist to visit the GP.

Secondary outcomes

Secondary outcomes will be the percentage of individuals diagnosed with T2DM, IGR hypertension or high cholesterol as a result of the screening intervention.

Search methods

We will use the following electronic sources for the identification of relevant trials:

• MEDLINE (Until recent)
• PubMed (Until recent)
• EMBASE (Until recent)
• Cochrane database of RCTs

We will also conduct a rigorous manual search of reference lists from relevant trials and systematic reviews.

We have developed a search strategy which will be adapted for use with the three electronic databases listed above. The search strategy is comprised of four layers of keywords (MeSH headings) and text words for T2DM, CVD, Screening and pharmacy.

Data collection

Study selection

In order to select relevant studies to be included in the review two reviewers (AW and SH) will independently scan the titles, abstract and keyword section of all titles
identified. Where a difference of opinion exists regarding inclusion in the review third party intervention will be sought.

**Data extraction**

Data will be extracted independently by two reviewers (AW and SH) using a standardised data extraction form with any disagreements or discrepancies being resolved through third party intervention. All included studies will have the following data recorded on the data extraction form:

- Participant demographics (age, sex etc)
- Characteristics of the intervention used and the control used.
- Outcomes reported.
- Any missing data will be noted and if deemed appropriate efforts will be made to gain this data from the original author/authors.

**Assessment of study quality**

Study quality will be carried out using the US preventative services quality rating criteria for both randomised and non-randomised trial designs. Study quality assessment will be carried out by two reviewers (AW and SH) any discrepancies in quality assessment will be resolved by third party intervention.

**Data analysis**

Data will be analysed using Stata (version 11.0). Statistical significance relates to $p < 0.05$, and 95% CIs will be presented throughout.

**Assessment of heterogeneity**

Between study heterogeneity will be assessed using the $I^2$ where a value greater than 75% indicates a high level of heterogeneity$^{201}$.

**References**


1.2 Review search strategy

1. Type 2 Diabetes Mellitus


2. Cardiovascular Disease

(“Cardiovascular Diseases”[MeSH], cardiovascular OR heart OR cardiac OR coronary OR vascular OR angina OR stroke OR myocardial OR vessel OR vessels OR artery OR arterial OR arteries)

3 Screening

(mass screening [mh]) OR (screen* [tw])

4 Pharmacy based
pharmacy OR pharmacies [tw], pharmacist [tw], pharmacist-led [tw], pharmacist initiated or ((driven or lead or led) adj2 pharmacist?)) [tw]

(1 OR 2) AND 3 AND 4
### 1.3 Review data extraction form

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<td>NOTES</td>
</tr>
<tr>
<td>First author</td>
<td>Title of paper</td>
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<tr>
<td></td>
<td>Journal</td>
</tr>
<tr>
<td></td>
<td>Publication date</td>
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<td></td>
<td>Language and country of first author:</td>
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<td></td>
<td>Notes</td>
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<tr>
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<td>PRIMARY OUTCOMES: Upake to pharmacy referral</td>
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<td></td>
<td>Period of follow-up: Sample Size:</td>
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<tr>
<td>Screened for:</td>
<td>Outcome measures: Percentage uptake to pharmacy referral:</td>
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<td></td>
<td>Screened by: Screening tool:</td>
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<tr>
<td></td>
<td>Other info on screening: Risk Score used:</td>
</tr>
<tr>
<td></td>
<td>% found at high risk: % referred:</td>
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<tr>
<td>SCREENING INTERVENTION</td>
<td>SECONDARY OUTCOMES:</td>
</tr>
<tr>
<td>Screened for:</td>
<td>Secondary detected prevalence of diabetes, CVD, high risk status (field):</td>
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</table>

#### Data extraction form

- **Diabetes or CVD risk assessment or other data collection:**
- **Exclusion criteria:**
- **Number screened:**
- **Total:**
- **Men:**
- **Women:**
- **Mean age (± SD):**
- **Ethnicity:**
- **Recruitment date/period:**
<table>
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<th>Method of measuring</th>
<th>Prevalence</th>
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<td>Diabetes/IGT/20% CVD risk/CVD risk factor</td>
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1.4. Quality assessment criteria checklist

**US Preventative Services Quality Rating Criteria**

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<tr>
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<td>Initial assembly of comparable groups: RCTs—adequate randomization,</td>
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<td>distributed equally among groups; cohort studies—consideration of</td>
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<tr>
<td>potential confounders with either restriction or measurement for</td>
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<tr>
<td>adjustment in the analysis; consideration of inception cohorts</td>
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<tr>
<td>Maintenance of comparable groups (includes attrition, cross-overs,</td>
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<td>adherence, contamination)</td>
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<td></td>
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<tr>
<td>Measurements: equal, reliable, and valid (includes masking of outcome</td>
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<td>assessment)</td>
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<td></td>
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<tr>
<td>Clear definition of interventions</td>
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<tr>
<td>Important outcomes considered</td>
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<td>Analysis: adjustment for potential confounders for cohort studies or</td>
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<tr>
<td>intention-to-treat analysis for RCTs; for cluster RCTs, correction</td>
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<tr>
<td>for correlation coefficient</td>
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</table>

**Good:** Meets all criteria: comparable groups are assembled initially and maintained throughout the study (follow-up at least 80%); reliable and valid measurement instruments are used and applied equally to the groups; interventions are spelled out clearly; important outcomes are considered; and appropriate attention to confounders in analysis.

**Fair:** Studies will be graded “fair” if any or all of the following problems occur, without the important limitations noted in the “poor” category below: generally comparable groups are assembled initially but some question remains whether some (although not major) differences occurred in follow-up; measurement instruments are acceptable (although not the best) and generally applied equally; some, but not all, important outcomes are considered; and some, but not all, potential confounders are accounted for.

**Poor:** Studies will be graded “poor” if any of the following major limitations exist: groups assembled initially are not close to being comparable or maintained throughout the study; unreliable or invalid measurement instruments are used or not applied equally among groups (including not masking the outcome assessment); and key confounders are given little or no attention.
Appendix 2. Supplementary material relating to the PRISM study quantitative analysis

Appendix 2.1 NHS ethics and local R&D approvals documentation

Appendix 2.2 Participant consent form and patient information leaflet

Appendix 2.3 Pharmacy site file

Appendix 2.4 Pharmacist monthly feedback

Appendix 2.5 Leicester self-assessment risk score

Appendix 2.6 Promotional flyer/poster for use in pharmacies

Appendix 2.7 Data Collection Form

Appendix 2.8 GP and participant referral letters

Appendix 2.9 Baseline questionnaire booklet

Appendix 2.10 GP follow up data collection form

Appendix 2.11 Statistical analysis output
2.1 NHS ethics and local R&D approvals documentation

Appendix two

Page 2 of 3

The Committee acknowledged that they would be happy to explain the risks and benefits
in detail.

5. The Committee received a letter from NHS England stating that they would be able to
issue blanket approvals for research projects involving less than 5% chance of patients
being affected. The letter stated that the Committee would be able to approve research
projects with local R&D approvals, provided that the study was deemed to be
ethically acceptable.

6. The Committee discussed the impact of the new regulations on the research
community and agreed that they would be happy to continue to work with the
researchers to ensure that ethical standards were maintained.

7. The Committee decided to establish a working group to develop a new framework for
reviewing research proposals involving less than 5% chance of patients being
affected.

8. The Committee agreed to work with NHS England to ensure that the new framework
was implemented as efficiently as possible.

9. The Committee requested that the research community be informed of the new
framework and that they would be willing to answer any questions that might arise.

10. The Committee concluded that the new framework would be beneficial to both
patients and researchers and that they would be happy to support the implementation
of the new framework.
Appendix two

Dear Professor Khondk,

Project Title: Evaluating Two Methods of Screening for Type 2 Diabetes in Pharmacies
PRISM
Ethics Reference: 10/H0402/40
CSP Reference: 28966

I am pleased to inform you that your project has gained organisational approval on 7 September 2012 and you can proceed with your project within Lincolnshire Community Health Services (LCHS) NHS Trust and NHS Lincolnshire.

Please note that this approval does not cover other health organisations within Lincolnshire and therefore if your research is being conducted elsewhere, then you will also need to apply to that relevant Research & Development Department for approval.

Please also note that if your research has been adopted by the National Institute for Health Research or networks then it is a condition of LCHS NHS Trust approval to ensure that accrual data pertaining to LCHS NHS Trust and LCHS Lincolnshire is uploaded on a monthly basis to the appropriate codes in respect of where recruitment is taking place in Lincolnshire.

Conditions of organisational approval include ensuring that the following are adhered to:

- Consent procedures
- Caldicott, data and confidentiality issues
- Health and Safety issues
- Participation with research monitoring

As part of the research governance process all active research projects are routinely monitored; the level of monitoring will depend on the degree of risk associated with the research project.

Please note that the monitoring form will request certain information regarding accrual figures.

At least 10% of research projects will be audited; this means that the Research Governance Administrator may visit you and check the procedures you have in place. We would inform you in writing prior to any visit and arrange a suitable date and time with you or your representative.

All lead researchers must submit details of any amendments in their research in accordance with IRAS guidance e.g. change of protocol, substantial amendments, change of personnel, any adverse incidents etc.

We would also like to remind researchers they must declare any conflict of interest that they may have including commercial interests/income, other research grants etc.

Putting your trust at the heart of everything we do

Chairman: Dr Dan White
Chief Executive: Ellen Smith

clarify stated.

a. As discussed the potential risks and benefits should be explained in more detail. This should include potential lifestyle restrictions, implication for insurance and the benefits of early detection and treatment.

b. The potential for a false negative should be explained.

c. If the patient’s GP will be informed of participation this should be explained.

d. An independent contact for complaints should be included; this would normally be the relevant NHS complaints department or PALS.

7. The following changes are required to the consent form:

a. If the GP will be notified of participation statement 4 should be removed.

b. Statement 1 should be updated to refer to the final version number and date of the information sheet.

If you have any queries about the content of this letter, please contact Susie Cornick-Willis on 0116 8893668 or susie.cornick-willis@nottspt.nhs.uk who will be replacing Jeanie Motley as the Committee Coordinator from 01 July 2010.

When submitting your response to the Committee, please send the revised documentation with appropriate underlining or otherwise highlighting the changes you have made and giving revised version numbers and dates. It would help to speed up review of your response if you would email your response as well as sending a hard copy.

If the committee has asked for clarification or changes to any answers given in the application form, please do not submit a revised copy of the application form; these can be addressed in a covering letter to the REC.

The Committee will confirm the final ethical opinion within a maximum of 60 days from the date of initial receipt of the application, excluding the time taken by you to respond fully to the above points. A response should be submitted by no later than 23 October 2010.

Membership of the Committee
The members of the Committee who were present at the meeting are listed on the attached sheet.

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

10/H0402/40 Please quote this number on all correspondence

Yours sincerely

Mr Ken Willis
Chair

Email: jeannie.motley@nottspt.nhs.uk

Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments.
Appendix Two

Leicester, Leicestershire & Rutland Primary Care Research Office
C/o Leicester, Northamptonshire and Rutland Comprehensive Local Research Network
Second Floor, Marriott Ward
Victoria Building
Leicester Royal Infirmary
Leicester, LE1 9YW

Professor Kamlesh Khunti
Professor of Primary Care Diabetes & Vascular Medicine
University of Leicester
Department of Health Sciences
22-26 Princess Road West
Leicester
LE1 6TP

13th October 2010

CSP Ref.: 28965
REC Ref.: 10/H0402/160
Portfolio Ref.: TBC

Dear Kamlesh,

I am pleased to confirm that NHS Leicester City has reviewed your research study titled ‘Evaluating Two Methods of Screening Type 2 Diabetes in Pharmacies’ (The PRISM Study) using the Coordinated System for gaining NHS Permission (CSP) and gives approval for you to conduct this research within the Trust on the condition that the Trust suffers no cost as a result of this study being undertaken. Your research has been entered onto the Trust’s Research Database.

Please reply to this letter confirming the expected start date and duration of the study. As part of the Research Governance Framework it is important that the Trust is notified as to the outcome of your research and as such we will request feedback once the research has finished along with details of dissemination of your findings. We may also request brief updates of your progress from time to time, dependant on duration of the study. Similarly, if at anytime details relating to the research project or research team change, the R&D department must be informed.

If you have any further questions regarding this or other research you may wish to undertake in the Trust, please feel free to contact me again. The Trust wishes you success with your research.

Yours sincerely,

Clare O’Neill
RM&D Manager - Primary Care
Tel: 0116 258 7651
Email: clare.onnell@dh-tr.nhs.uk

CC: Red Moore - Deputy Director of Public Health and Health Improvement, NHS Leicester City
Andrew Willis - Research Assistant, University of Leicester

LCHS NHS Trust follows the requirements of the Freedom of Information Act and the details of such studies and completed research study will be published on LCHS NHS Trust website unless you specify, in writing to us, otherwise.

Please contact us if you would like any information about the research governance arrangements. We wish you every success with your research.

Yours sincerely,

Janice Whiteman
Research Manager

CC – Mr Graham Hewitt, Research Governance Manager, University of Leicester ugh13@le.ac.uk
Participant consent form and patient information leaflet

Patient Information Sheet

You are being invited to volunteer to take part in a research study. Before you decide whether to take part you should fully understand why the research is being done and what it will involve. Please read the following information carefully and discuss it with your pharmacist if there is anything that is not clear or if you would like more information.

What is the purpose of this study?
Traditionally, screening tests for diabetes have been done on an informal basis and have involved giving people a blood test that is expensive to administer and means the person having it needs to fast from the night before which can be an inconvenience. This study is being done to see whether we can use more convenient screening methods to identify people who need further blood tests to make sure that those tests are only given to those who need them. This study is also being done to see whether people are happy to attend screening appointments for diabetes at their local pharmacy instead of their general practice.

Why have I been chosen to take part?
You have been chosen to take part because you are above the age of 40 (55 if you are of south Asian ethnicity) which means you are in a higher risk category for diabetes. You have also been chosen as you have not had a screening test for diabetes within the past 12 months.

Do I have to take part?
It is your right to decide whether or not you would like to take part in this study. Your medical care will not be affected by whether or not you take part. You can withdraw your consent from the study by contacting your local pharmacy and notifying them. If you do this, your pharmacy will not pass on any more details to the University of Leicester and will ensure that the details held are carefully destroyed. You can also withdraw from this research at any point without having to give any reason for doing so. If you choose to do this your medical care will not be affected in any way.

What will be involved if I take part?
You will be asked to sign a form as written evidence that you have agreed to take part (this is not a contract and does not mean you definitely have to take part, you can still stop taking part at any point during the study). You will be asked to fill out a questionnaire to calculate a score with your pharmacist that will tell you your risk of having diabetes. You can do this straight away or make an appointment to come back for screening tests at a more convenient time. If your score on the questionnaire is 16 or higher you will then be offered the opportunity to either:

- give a finger prick blood sample to test your HbA1c level. HbA1c tells us how high your blood sugar levels have been over the past 2-3 months and can be used to

C O N S E N T F O R M

Title of Project: Evaluating Two Methods of Screening for Type 2 Diabetes in pharmacies

Name of Researcher: Professor Kamlesh Khunti

Please initial box

1. I confirm that I have read and understand the information sheet dated 12/07/2010 version 2 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

3. I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from the research team or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

4. I agree to my GP being informed of my participation in the study.

5. I agree to take part in the above study.

Name of Patient __________________________ Date __________ Signature __________________________

Name of Person taking consent (if different from researcher) __________________________ Date __________ Signature __________________________

Researcher __________________________ Date __________ Signature __________________________

When completed, 1 for patient; 1 for researcher site file; 1 (original) to be kept in medical notes
Appendix two

Patient Information Sheet V3  20/10/12
Evaluating Two Methods of Screening for Type 2 Diabetes in pharmacies

and a small number of the research team will have the information to link patient names and reference numbers. If you

What will happen to the results of the study?
The results of this research may be published in a medical journal or presented at research meetings or conferences. All data will be analysed and displayed collectively. All results will be presented as averages and a single person's data will not be presented.

Who is responsible for this research?
This research is being carried out by the University of Leicester. The Principal Investigator, who will take responsibility for the study, is Professor Kamlesh Khunti.

Who has reviewed this study?
To protect your safety, rights, well-being and dignity, all research involving patients is looked at by an independent group of people, called a Research Ethics Committee. This study has been reviewed by the appropriate ethics committee in accordance with local regulations.

What if I am harmed by the study?
It is very unlikely that you would be harmed by taking part in this type of research study. However, if you wish to complain or have any concerns about the way you have been approached or treated in connection with the study, you should ask to speak to Professor Kamlesh Khunti (0116 252 5445) who will do their best to answer your questions. If you remain unhappy and wish to address your concerns or complaints on a formal basis, you should contact Patient Advice & Liaison Service at www.pals.nhs.uk or your local PALS office at Leicester City PCT, St. John's Hospital, 30 East Street, Leicester LE1 6NB Tel: 0116 205 7011

What do I do if I decide to volunteer?
If you have decided to volunteer, you will be asked to sign a consent form and you can take this consent for home with you in case there is anything you would like to read again and as a record of what you have agreed to.

If you still have any questions about the study please feel free to contact:

Andrew Willis
Department of Health Sciences,
University of Leicester,
22-28 Princess Road West,
Leicester, LE1 6TP.
Telephone: 0116 252 5452

Patient Information Sheet V3  20/10/12
Evaluating Two Methods of Screening for Type 2 Diabetes in pharmacies

identify people who have diabetes. If you have a Hba1c level of 6% or more you will be asked to go to your GP for more accurate blood tests to find out if you have diabetes.

Or

+ To have a chat about your risk of getting diabetes and how you can help to reduce this risk. After this appointment you will be asked to go to your GP for blood tests to find out if you have diabetes.

It will be decided whether you receive a fingerpick blood test or be asked to go for a blood test at your GP before you attend. It will not be decided by yourself or the pharmacist. This is done to ensure that the same number of people with the same characteristics (age, ethnicity, male/female) are spread evenly between the two screening methods being tested.

You will be sent a copy of a questionnaire 3.6 and 12 months after the screening appointment (the same one you have filled out during the screening appointment) to see if any of your views have changed after having the screening test done. You will be asked to post this back in a pre-paid envelope.

What is the screening tool being tested?
This risk score being tested uses information about a person to find out how likely they are of having diabetes or having higher than normal blood sugar that makes them at risk of having diabetes in the future. Giving everyone blood tests can be costly and takes time. These risk scores can save time and money by identifying only those people that need a blood test. The self-assessment gives you a score based on your answers to a few simple questions. If your score is above a certain value then it is important for you to have a blood test.

What are the potential disadvantages and risks of taking part?
There is a slight risk of being injured by the needle used to take your blood test during the study but the risks are minimal and all tests will be done by people with adequate training and qualifications. If you are diagnosed with diabetes during this study this may affect your health insurance premium. If you are diagnosed with diabetes in some cases you may be unable to perform certain jobs such as driving HGV’s. However, the earlier we can diagnose diabetes the smaller the risk of this happening. It is also important that you understand that the risk score and fingerpick test being used in this study are screening tests not diagnostic tests and so are not foolproof. There is a small chance that you may have diabetes and this will not show on this test. This is called a ‘false negative’. Those people with a high risk score and blood result will be asked to attend their GP for a more accurate test to see if you have diabetes or not.

What information about me will be taken and will it be confidential?
We will record basic information like your age, gender, smoking status, height and weight, the score from your questionnaire, the results from your blood tests and any information gained from questionnaires or interviews. All of this information will be treated as confidential. You will not be referred to by name during the analysis of your results instead we will use a 5 digit reference number. Only your pharmacist
2.3 Pharmacy information file
BACKGROUND

The demand for initial screening appointments could potentially be reduced by the use of a near patient test (NPT). Near patient testing is defined as: "Diagnostic testing that is performed near to or at the site of the patient care with the result leading to possible change in the care of the patient."

The use of NPT’s has been advocated by the Department of Health as a means of supporting the NHS ‘Health Checks’ programme and has a number of advantages over laboratory testing. As results are immediately available they can be combined with personalised lifestyle advice in one single screening session. This may have the effect of increasing uptake of any further necessary tests at their local practice and improved motivation to modify lifestyle factors.

Community pharmacies are in a strong position to conduct NPT’s to identify patients at risk of type 2 diabetes mellitus (T2DM) and vascular disease. There are two main benefits of integrating pharmacies into the screening process. Firstly, pharmacies are capable of offering a simple paper based screening tool which would reduce the number of low risk patients being unnecessarily screened at general practice. Secondly, individuals who may not regularly attend their general practice, or are not registered with a general practice are less likely to receive screening and be referred if they are found to be at high risk.

STUDY DESIGN

This study is a pragmatic randomised trial assessing two screening methods for opportunistically screening individuals for T2DM (and impaired glucose regulation, IGR) in line with the recently implemented NHS ‘Health Check’ programme. The hypothesis to be tested is that screening using a self assessed risk score followed by near patient HbA1c testing in pharmacies will increase uptake of a confirmatory test conducted at the GP practice compared to screening with a risk score alone.

CONTACT DETAILS

If you have queries about the study or require HbA1c machine consumables please contact

Andy Willis awl1@le.ac.uk 01162525429
Stephen Hiles sh66@le.ac.uk 01162525449
Bill O’Leary wo2@le.ac.uk 01162525478

Generally one of us will be in the office at all times (Monday to Friday 8am to 5pm). If you cannot get hold of either of us we may be out of the office. Alternatively call 0116 2523277 and leave a message and we will get back to you as soon as possible.

Our postal address is:

The PRISM Study
CIANRC office
Department of Health Sciences
222 28 Princess Road West
University of Leicester
Leicester
LE1 6TP

If you have a technical queries about the machine please refer to the manual and follow the contact details for Siemens.

Technical Support: 0845 6001955.
**Study Methods**

A paper-based version of the LSA will be given to all individuals who are approached at the pharmacy over the recruitment period and meet the inclusion criteria for the study. Participants with a high LSA risk score (>1.6 points) randomised to either:

A A near patient HbA1c test and a discussion about modifiable risk factors. If the individual presents with a HbA1c greater than or equal to 6% they will be referred to their GP for a confirmatory Oral Glucose Tolerance Test (OGTT).

B A discussion about modifiable risk factors. Following this consultation they will be given a letter of referral asking for an HbA1c or fasting plasma glucose (FPG) test to be performed at their general practice. If the individual presents with a HbA1c above 6% or a FPG of 6mmol/L or above they will be asked to reattend their general practice for a confirmatory OGTT.

**Study Payments**

Payment will be based on complete data records, specifically a signed consent form and completed data collection form. These records will be collected on a regular basis by the research team and the pharmacy will be invited to submit an invoice for the appropriate amount.

**Study Aims**

- To assess the effect of pharmacy screening using a self assessment risk score followed by near patient testing of HbA1c at local pharmacies or general practices on levels of uptake to a confirmatory OGTT at their general practice compared to using a self assessment risk score alone.
- To assess the patient, pharmacist and general practitioner acceptability of two different screening methods for IGR and 12DM.
- To assess the effect of the screening programme and results of screening tests on perceptions of diabetes and quality of life.

**Primary Outcome**

- Uptake of high risk individuals to an OGTT test at the GP surgery.

**Secondary Outcomes**

- Patient, pharmacist and practitioner views on the general acceptability/ease of use of two different screening methods.
- Yield in positive tests for 12DM and IGR according to the final confirmatory test at the GP surgery.
- Proportion of patients who were unnecessarily tested due to them having had a diabetes screening test in the previous 12 months.
- Association between illness perception measured by the brief illness perception questionnaire (BFI-PQ) and uptake to the final confirmatory test at the GP surgery.

**Study Outline**

The study aims to screen 2406 screen individuals from 10 community pharmacies by using either a Leicester Self Assessment* or a Leicester Self Assessment and a HbA1c near patient test.

**Funding and ethical approval**

The study is funded by CLAHRC, Leicester Cty, CDT and MSD. It is been fully approved by the Leicestshire, Northamptonshire & Rutland ethics committee, the Primary Care Research Network (PCRN) and participating GPs.
Participant Information Pack

The participant information will include:
- Randomisation code for the participant
- An information sheet about the study
- Leicester Self Assessment risk score
- Participant result letter
- GP referral letter

Informed Consent

It is essential that all participants are consented so they can be enrolled in the study and their data collected. Training will be provided for pharmacists so they are aware of the ethical considerations when obtaining informed consent. Please refer to the informed consent training materials and standard operating procedure (SOP) in the site file appendix.

Recruitment of Pharmacies

Pharmacies that are currently, or have in the past, carried out NPT screening for cardiovascular disease risk will be identified and sent a letter of invitation with details of the study. If the number of pharmacies that volunteer exceeds the number of pharmacies required for the study, the final selection of sites will be based on including a range in terms of size, location and current vascular check activities.

Recruitment of Participants

The identification strategy for this study will be opportunistic for individuals who attend pharmacies, fulfill the inclusion criteria and then invited to complete the LSA questionnaire and calculate their risk score. If this is > 10 points they will be invited to participate in the next stage of the screening procedure.

Inclusion Criteria

- Aged between 40 and 75 years. Participants from any GP practice will be included.
- Individuals who are not already being diagnosed with diabetes
- Individuals do not have a terminal illness and mental impairment or learning disability leading to inability to provide informed consent
- Individuals who report they have not been screened for T2DM within the past 12 months.

Randomisation

Randomisation will take place at individual level with 2406 participants being randomised to either the NPT method or GP test method. Patient information packs will be put together in sealed envelopes and placed in a random order in each pharmacy containing instructions as to which group the participant is randomised.
**Body Mass Index (BMI)**

BMI is a general measure of how healthy an individual’s weight is for their height. It is calculated by dividing weight in kilograms by the square of height in metres. To avoid confusion with the calculation a BMI table is provided on the LSA for people to read off their BMI knowing their height and weight in metric or imperial units, it may be preferable to provide a set of scales and a stadiometer to measure current weight and height for a more precise assessment of BMI.

![BMI Table](image)

**Waist Circumference**

Waist circumference is known to be inaccurate when self-reported unless written or visual instructions are given. The LSA provides these instructions and an SOP for measuring waist circumference is provided for information.

Measuring the waist is straightforward if these instructions are followed. First get a tape measure and:
1. Find the bottom rib
2. Find the top of the hip bone
3. Place the tape half way between the bottom rib and the top of the hip bone
4. Read the waist measurement in centimetres

---

**Leicester Self Assessment**

The Leicester Self Assessment (LSA) tool is a simple, non-invasive diabetes risk score that was developed from the ADDITION Leicester study which were residents within the Leicestershire area and reflect the diverse regional population demographics. The score was validated and then published in Diabetic Medicine [August 2010]. The presentation of the risk score was developed using public and patient groups.

The LSA consists of 7 questions that can be completed by an individual on their own or with a health care professional assisting. The main issues for completing the LSA is with the body mass index (BMI) calculation and an accurate measure of waist circumference.

![LSA Diagram](image)
Data Collection

It is vital to collect other basic demographic information about each participant that completes the LSA. This will include personal contact information, age, gender, ethnicity, postcode and general practice where the individual is registered. Data collection sheet will accompany each risk score. An unique ID code will link the risk score and the data collection sheet.

In addition to the data collection sheet we would also like to collect responses to a short questionnaire that will also be linked by a unique ID code. The questionnaire includes EQ-SD that provides a simple indicator of health status; and the Brief Illness Perception Questionnaire (BIPQ) that seeks to establish participants’ perceptions of diabetes and their perceived ability to manage their own risk. Received risk of diabetes will be measured using two questions taken from a previous large scale screening study. This questionnaire will also be used to measure false reassurance of a negative screening test at 3, 6 and 12 months. Similarly, individuals that have a positive screening test will also be sent the questionnaire at 3, 6 and 12 months.

Follow-up Data

Data will be extracted from practice databases to ascertain whether an individual attended or not, for the results of the referral blood tests and, results of the OGT1. Also we will check to see if there are any records of diabetes screening tests within the last 12 months to confirm response to the inclusion criteria.

Qualitative Data

A qualitative study will contribute to the evaluation of the intervention by exploring the perspectives of a sample of both patients and pharmacy staff on the feasibility and acceptability of the programme. This portion of the study will take place towards the end of the recruitment period. Each pharmacy and all participants will have the option to take part. Data generated and resulting analysis will also contribute to the final report.
2.4 Pharmacist monthly feedback

Dear Mr. Pharmacist,

Thank you for your ongoing participation in the initial study.

In order to further improve the quality of your feedback, we have added the following changes:

- We have removed the question regarding adverse events. This has been removed.
- We have also changed the frequency of feedback collection from monthly to weekly.

Below is a graph showing the trend in feedback received, along with the number of participants involved in the study. As you can see, there has been a significant increase in feedback since the last report.

Many thanks for your efforts in assessing patients for this study and please do not hesitate to contact the research team if you feel there is anyway we can assist in speeding up participant recruitment for this study.

Yours sincerely,

[Signature]

Professor Karen Wilfi

University of Leicester
2.5 Leicester self-assessment risk score

The Leicester Self-Assessment Risk Score for the PRISM Study

To complete this assessment and add up your score at the end, you will need to know your weight, your height, your waist circumference and your BMI. If you need help to calculate your BMI or waist circumference please see page 10.

1. Are you male or female?
   - Male: 0
   - Female: 1

2. How would you describe your ethnicity?
   - European Group: 0
   - Other Ethnic Group: 6

3. How old are you?
   - 50 - 59: 0
   - 60 - 69: 9
   - 70 and older: 13

4. What is your Body Mass Index (BMI)? (See instructions on page 9)
   - Less than 25: 0
   - 25 - 29: 3
   - 30 - 34: 5
   - 35 & above: 8

5. What is your waist circumference? (See instructions on page 9)
   - Less than 35.3 inches: 4
   - 35.4 - 39 inches: 6
   - 39.1 - 42.9 inches: 9
   - 43 inches and above: 0

6. Has a doctor given you medication for high blood pressure or told you that you have high blood pressure?
   - Yes: 5
   - No: 0

7. Do you have a father, mother, brother, sister and/or other child with type 1 or type 2 diabetes?
   - Yes: 5
   - No: 0

Add up your score here -

- 16 or more points
  - HIGH RISK
  - You are at high risk of developing diabetes.
  - Consider diet, weight and lifestyle changes.

- 7 - 18 points
  - MODERATE RISK
  - You are at increased risk of developing diabetes.
  - Consider lifestyle changes.

- 0 - 6 points
  - LOW RISK
  - You are at low risk of developing diabetes.
  - Consider your diet and lifestyle.

How does your score mean?

- 16 or more points:
  - You are at high risk of developing diabetes.
  - Consider diet, weight and lifestyle changes.

- 7 - 18 points:
  - You are at increased risk of developing diabetes.
  - Consider lifestyle changes.

- 0 - 6 points:
  - You are at low risk of developing diabetes.
  - Consider your diet and lifestyle.
2.6 Promotional flyer/poster for use in pharmacies

Would you like to take part in study about your Diabetes risk?

Are you...
- aged between 40 - 75 years
- and do not have diabetes already
then come in and speak to the pharmacist about your risk of diabetes.

Your pharmacist, Leicester City PCT and the University of Leicester have teamed up to give you the opportunity to take part in an important study to test your risk of developing diabetes.

The University of Leicester have developed a risk score that tells you how likely you are of having undiagnosed diabetes right now and what your risk is of developing diabetes over the next 10 years.

You may feel fine but Type 2 Diabetes can develop over a number of years and is often found to be quite advanced. Diabetes can cause heart attack, strokes and major problems with your eyes, feet and kidneys. It is not managed early enough.

This work is being carried out in collaboration with the Medical Research Council (MRC) Centre for Longitudinal Studies and the Medical Research Council (MRC) Unit for the Evaluation of Health Promotion in the Community (HEPAC) (RRF) © University of Leicester 2013.
2.7 Data collection form
2.8 General practice and participant referral letters

Appendix two

Andrew Willis
2.9 Questionnaire booklet

The PRISM Study Questionnaire

Diabetes Risk Perception

Question 1: Compared to other people of your age, what are your chances of getting diabetes at some time in your life? Mark the scale below.

much lower    lower    about the same    a little higher    much higher

10%  20%  30%  40%  50%  60%  70%  80%  90%  100%

Question 2: If you were told that you had very high blood glucose levels, at what point would you say your chances of getting diabetes were increasing?

Patient ID

Date

Andrew Willis


Page 184
EQ-5D Questionnaire

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

**Mobility**
- I have no problems in walking about
- I have some problems in walking about
- I am confined to bed

**Self-Care**
- I have no problems with self-care
- I have some problems washing or dressing myself
- I am unable to wash or dress myself

**Usual Activities** (e.g. work, study, housework, family or leisure activities)
- I have no problems with performing my usual activities
- I have some problems with performing my usual activities
- I am unable to perform my usual activities

**Pain/Discomfort**
- I have no pain or discomfort
- I have moderate pain or discomfort
- I have extreme pain or discomfort

**Anxiety/Depression**
- I am not anxious or depressed
- I am moderately anxious or depressed
- I am extremely anxious or depressed

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0. We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line across a point on the scale indicates how good or bad your health state is today.

---

Brief Illness Perception Questionnaire

These questions are about how you perceive your risk of type 2 diabetes

On the following questions, please circle the number that best corresponds to your views

**How long do you think an increased risk of developing diabetes will last?**

- A very short time
- Forever

0 1 2 3 4 5 6 7 8 9 10

**To what extent do you feel that you can control your risk of type 2 diabetes?**

- Absolutely no control
- Complete control

0 1 2 3 4 5 6 7 8 9 10

**How much do you think exercise can help reduce your risk of type 2 diabetes?**

- Not at all
- Extremely helpful

0 1 2 3 4 5 6 7 8 9 10

**Are you experiencing any symptoms which make you think you may be at a higher risk of type 2 diabetes?**

- No symptoms at all
- Many severe symptoms

0 1 2 3 4 5 6 7 8 9 10

**How concerned would you feel if you were informed that you were at an increased risk of developing diabetes?**

- Not at all concerned
- Extremely concerned

0 1 2 3 4 5 6 7 8 9 10

**How well do you feel that you understand the implications of being at risk of type 2 diabetes?**

- Don’t understand it at all
- Understand it very clearly

0 1 2 3 4 5 6 7 8 9 10

**If you were told you are at an increased risk of developing type 2 diabetes how do you think that it would affect you emotionally (e.g. does it make you angry, scared, upset or depressed)?**

- Not at all affected emotionally
- Extremely affected emotionally

0 1 2 3 4 5 6 7 8 9 10

FRAM Questionnaire v3.11 27th November 2010
Dear Colleague,

I am writing to inform you that PRISM, a new research study, is due to start in Leicester in the coming weeks. It is being co-ordinated by the University of Leicester with support from Leicester City PCT and Merck Sharp & Dohm.

PRISM is a pilot of two different methods of screening for undiagnosed diabetes with the initial phase being conducted by community pharmacists. Participants will fill out a version of the paper based Leicester self-assessment risk score. This has been shown to have very good sensitivity and specificity for detecting undiagnosed diabetes and impaired glucose regulation in a multi-ethnic population in Leicester. If participants are found to be at risk following this questionnaire they will be randomly allocated to receive an HbA1c test at the pharmacy or be referred to their GP for follow-up in line with routine care. Patients who have a HbA1c greater than 6 will be referred to their GP for confirmatory tests.

The study will assess the uptake to further tests at the GP surgery following an initial screening appointment with a local pharmacist. In particular, it is assessing the effect of having a near patient test and result for HbA1c at the pharmacy and how this can influence the communication and interpretation of the participants diabetes risk and subsequent uptake of a GP referral in those found to be at high risk.

The study will aim to recruit 2206 participants over a period of approximately 1 year. Each of the 14 pharmacies will recruit 220 patients and it is anticipated that from each community pharmacy 60 patients would be referred by the pharmacist following a high risk score for follow up. A further 18 would be referred following a HbA1c result of greater than 6% for confirmatory tests. The costs of these blood tests will be met by the PCT.

Regardless of the screening test result, the pharmacist will send out a results letter to every participant’s general practice informing them of their participation in the study, their risk score and HbA1c results.

More information about the PRISM study can be found at http://www.leicestershire.nhs.uk/prismstudy

If you have any concerns or questions regarding this study please contact the study co-ordinator Andrew Willis by phone on 0116 202 5492 or by email at awil187@le.ac.uk.

Yours Sincerely,

[Signature]

Professor Karmel Khunti
Appendix two

DR DATA COLLECTION FORM

Date of Pharmacy Appointment

Fasting test in previous 12 months  Yes  No

Date of first blood test

Type of blood test

Result of blood test

Date of second blood test

Type of blood test

Result of blood test

Diagnosis

Evaluating Two Methods of Screening for Type 2 Diabetes in pharmacies

Data collection Form v1 3/8/2013
### 2.11 Supplementary general practice follow up data

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<th>Referred</th>
<th>Total (n=1901)</th>
<th>NPT Arm (n=964)</th>
<th>Non-NPT Arm (n=937)</th>
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<tbody>
<tr>
<td>Attended (%)</td>
<td>617</td>
<td>184</td>
<td>433</td>
</tr>
<tr>
<td>Did not attend (%)</td>
<td></td>
<td>111</td>
<td>223</td>
</tr>
<tr>
<td>Not followed up (%)</td>
<td>34</td>
<td>125</td>
<td>81</td>
</tr>
<tr>
<td>Appointment deemed ‘not suitable’ (%)</td>
<td>3</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>Not registered with a GP (%)</td>
<td>6</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Missing Data (%)</td>
<td>39</td>
<td>85</td>
<td></td>
</tr>
</tbody>
</table>

| Attended GP                   | 111            | 223            |                     |

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<tr>
<th>Attended first follow up appointment</th>
<th>Total (n=1901)</th>
<th>NPT Arm (n=964)</th>
<th>Non-NPT Arm (n=937)</th>
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<tbody>
<tr>
<td>HbA1c result available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6% (%)</td>
<td>76</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>6-6.4% (%)</td>
<td>36</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>≥6.5% (%)</td>
<td>29</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>FPG result available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6mmol/l (%)</td>
<td>40</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>6.1-6.9mmol/l (%)</td>
<td>31</td>
<td>93</td>
<td></td>
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<tr>
<td>≥7mmol/l (%)</td>
<td>7</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>OGTT result available</td>
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<td></td>
<td></td>
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<tr>
<td>Pre</td>
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<td></td>
<td></td>
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<td>6(66.67)</td>
<td></td>
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<tr>
<td>6.1-6.9mmol/l (%)</td>
<td>1(25)</td>
<td>0(0.00)</td>
<td></td>
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<tr>
<td>≥7mmol/l (%)</td>
<td>3(75.00)</td>
<td>3(3.33)</td>
<td></td>
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<tr>
<td>Post</td>
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<td></td>
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<td>&lt;7.8 mmol/l (%)</td>
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<td>5(55.56)</td>
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<td>7.8-11.1 %</td>
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<td>2(22.22)</td>
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<tr>
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<td>2(22.22)</td>
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<td>&lt;6% (%)</td>
<td>16</td>
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<td>6-6.4% (%)</td>
<td>10</td>
<td>12(52.17)</td>
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<td>≥6.5% (%)</td>
<td>6</td>
<td>3</td>
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<td>FPG result available</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6mmol/l (%)</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6.1-6.9mmol/l (%)</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≥7mmol/l (%)</td>
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<td></td>
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<td>OGTT result available</td>
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</tr>
<tr>
<td>Pre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6mmol/l (%)</td>
<td>2(50.00)</td>
<td>0(0.00)</td>
<td></td>
</tr>
<tr>
<td>6.1-6.9mmol/l (%)</td>
<td>0(0.00)</td>
<td>440(0.00)</td>
<td></td>
</tr>
<tr>
<td>≥7mmol/l (%)</td>
<td>2(50.00)</td>
<td>1(20.00)</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;7.8 mmol/l (%)</td>
<td>2(50.00)</td>
<td>0(0.00)</td>
<td></td>
</tr>
<tr>
<td>7.8-11.1 %</td>
<td>0(0.00)</td>
<td>3(60.00)</td>
<td></td>
</tr>
<tr>
<td>≥11.1 %</td>
<td>2(50.00)</td>
<td>2(40.00)</td>
<td></td>
</tr>
</tbody>
</table>

| Diabetes status                    |                |                |                     |
| Confirmed according to WHO criteria |                |                |                     |
| T2DM (% of total study arm)        | 36             | 16             | 20                  |
| IGR (% of total study arm)         | 71             | 37             | 34                  |
| Doctor diagnosed                   |                |                |                     |
| T2DM (% of total study arm)        | 49             | 25             | 24                  |
| IGR (% of total study arm)         | 71             | 37             | 34                  |
| Combined                            |                |                |                     |
| T2DM (% of total study arm)        | 50 (2.63)      | 26             | 24                  |
| IGR (% of total study arm)         | 71 (3.73)      | 37             | 34                  |

| Sensitivity analysis               |                |                |                     |
| Estimated overall prevalence rate  |                |                |                     |
| T2DM (% of total population screened (95% CI)) | 3.48 (2.70-4.40) | 3.56 (1.24-4.89) | 3.40 (2.35-4.79) |
| IGR (% of total population screened (95% CI))      | 4.55 (3.63-5.60) | 4.59 (3.34-6.08) | 4.54 (3.34-6.13) |
2.12 Statistical analysis output

Figure 5. Box plot showing summary of NPT HbA1c results

Figure 2. Frequency plot showing LSA risk scores from all study participants

Figure 3. Box plot summarising LSA risk scores for all participants
Figure 4. Box plot summarising risk scores for participants arranged by study arm
Appendix 3. Supplementary material relating to the qualitative evaluation of feasibility and acceptability

Appendix 3.1 Participant information leaflet and consent form

Appendix 3.2 Interview topic guide final version

Appendix 3.3 Coding framework
3.1 Participant information leaflet and consent form

Who has reviewed this study?
To protect your safety, rights, well-being and dignity, all research involving patients is looked at by an independent group of people, called a Research Ethics Committee. This study has been reviewed by the appropriate ethics committee in accordance with local regulations.

What if I am harmed by the study?
In this research we will just be interviewing people, so it is very unlikely that it will cause harm to anyone. However, if you wish to complain or have any concerns about the way you have been approached or treated in connection with the study, the normal National Health Service complaints mechanisms would be available to you.

Do I have to take part?
No, it’s up to you to decide. Even if you agree to take part, you can change your mind at any time, without giving a reason.

If you still have any questions about the study please feel free to contact:
Andrew Willis
Department of Health Sciences,
University of Leicester,
22-26 Princess Road West
Leicester
Telephone: 0116 252 5492

PHARMACIST INFORMATION SHEET
THE PRISM DIABETES SCREENING STUDY

You are being invited to participate in an interview as part of a research study. Before you decide you need to understand why the research is being done and what it will involve. Please read the following information carefully. Please ask us if there is anything that is not clear or if you would like more information.

Why is this research being done?
In this study, we would like to hear from pharmacists who have had provided PRISM study. This can help us improve our understanding of how pharmacists feel about the screening methods used. We are doing this find out if there is anything we can do to improve the screening methods in any way for use in future screening programmes.

What will be involved if I take part?
We are looking for pharmacy staff who will agree to being interviewed about the screening they have been involved in. The interviews will be carried out in your pharmacy of over the phone and will be audio (voice) recorded.

Will the interview be confidential?
The audio-recording will be treated in the strictest confidence and will be stored without your name on it. Anyone who takes part can request a copy of their interview tape if they wish. The audio-recording will be destroyed at the end of the study and your name will not be mentioned in the results. Your contact telephone number will be deleted from our records once the interview has been completed.

What will happen to the results of the study?
The results of this research may be published in a medical journal or presented at research meetings or conferences, but no names will be used.

Who is responsible for this research?
The Principal Investigator, who will take responsibility for the study, is Professor Kamlesh Khunti
PARTICIPANT CONSENT FORM

The PRISM Study

Please write your initials in each box.

1. I can confirm that I have read and understood the Pharmacist Information Sheet (Version 1, dated 19/10/13) for the above study and have had the opportunity to ask questions.

2. I understand that taking part is voluntary and that I am free to withdraw at any time, without giving a reason and without my medical care or legal rights being affected.

3. I understand that the interview will be audio-recorded but that all information will be strictly confidential.

4. I agree that any information collected as part of the study can be stored and analysed by the research team at the University of Leicester, and that small parts of what I say may be quoted anonymously when the results of the research are reported.

5. I understand that relevant actions of data collected during the study, may be looked at by individuals from the University of Leicester, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

6. I agree to take part in the study.

Name of participant (Print): ___________________________ Signature (Or mark): ___________________________ Date: ___________________________

To be completed by person taking consent

I can confirm that it is my opinion that the participant has understood what is involved in taking part in this study. If the participant is unable to read the information sheet and consent form, I can confirm that the content has been fully explained verbally.

Name of researcher (Print): ___________________________ Signature: ___________________________ Date: ___________________________
3.2 Interview topic guide final version

SERVICE
- How do you feel about providing the diabetes screening service?
  - Is it a positive or negative impact?
    - Why is that?
    - Have there been any particular problems you have encountered?
    - Is there anything you would do differently?
  - Do you feel you have the relevant skills to carry out this service?
    - Would you have liked any more training?
    - Could you do anything differently for your pharmacy?
    - What changes did you make?

- Did you feel you had enough time to carry out the screening appointments?
  - Yes, how do you manage your time?
  - No, what could have helped?

- What are your views on the support provided by the evaluation team?
  - Not enough, what would you like more support with?
    - Who and when did you feel you need more support?

EQUIPMENT
- How did you find the testing equipment?

PATIENT VIEWS/INTERACTION
- I want you to think back to someone you have screened recently.
  - Let's talk about someone who ended up with a positive result.
    - Can you tell me about that?
    - How did you explain the result?
  - Let's talk about someone who ended up with a negative result.
    - Can you tell me about that?
    - How did you explain the result?
    - How do you think the patient understood by this?

Do you feel the patient had relevant skills to carry out this service?
- (Doctors and nurses have training in delivering good and bad news, what about a pharmacist - how do you find delivering tests results etc.?)
  - Would you have liked any more training?

- What are your views on how the patients found the service?
  - Did they make any positive or negative comments?

SOUTH ASIAN SPECIFIC
- Is your pharmacy in an area populated with a high proportion of south Asian?
  - Next question
  - Do you have to adapt the service to better suit the population?
    - In what way?
    - Did this involve any extra work or take up extra time?

- Do you think South Asian people were more likely or less likely to take up the service?
  - Why do you think that is?
  - Did this make it easier or more difficult to provide the service?

FUTURE SERVICES
- How would you feel about carrying on the service in the future?
  - If this screening programme was adopted by all pharmacies do you think it could be improved in any way?

- Is there anything else you would like to add that we haven’t covered in the previous questions?

Thank you for your time and effort in taking part in this interview.
3.3 Coding framework

1. Evaluation of Service
   - Pharmacy Staff
     1.1 Pharmacy staff trained
     1.2 Effects of other staff involvement
     1.3 Frequency of training
     1.4 Effective management
   - Recruitment
     2.1 Ways in which potential participants were approached
     2.2 Which staff made initial approach?
     2.3 How were patients identified?
     2.4 Opportunistic or booked appointments
     2.5 Off site testing
   - Screening equipment used
     3.1 How equipment performed
     3.2 Problems with equipment

2. Patient Interactions/consultations
   - Personalising roles
     4.1 Dealing with high scores
     4.2 Dealing with low scores
     4.3 ‘Borderline’ cases
     4.4 Cultural/ethnicity adaptations
   - Identifying patients
     5.1 Visible risk factors
     5.2 Level of patient engagement
   - Risk communication tools
     6.1 FF/web use

3. GP Collaboration
   - GP collaboration
     7.1 Perceptions on the level of collaboration
     7.2 Barriers
     7.3 Facilitators
Appendix 4. Record of publications and copies of published manuscripts

Appendix 4.1 Oral and Poster presentations

Appendix 4.2 Other relevant publications

4.1 Oral and poster presentations

**CLAHRC KIP Event** ‘Optimising the contribution of pharmacists in developing and improving local health and social care services, The PRISM study and Experiences of community pharmacy involvement in research, Leicester, 2/2013

**Fourth NIHR Infrastructure Experimental Medicine Research Training Camp**, Ashridge, The Effectiveness of Community Pharmacy Initiated Screening for Diabetes: The PRISM Study, 6/2013

**HSRN Symposium** 2013, Nottingham: The Effectiveness of Community Pharmacy Initiated Screening for Diabetes: The PRISM Study, 6/2013

4.2 Other relevant publications


The Effectiveness of Screening for Diabetes and Cardiovascular Disease Risk Factors in a Community Pharmacy Setting

Andrew Willis¹, Peter Rivers², Laura J. Gray¹, Melanie Davies¹, Kamlesh Khunti¹

1 Diabetes Research Unit, University of Leicester, Leicester, United Kingdom; 2 De Montfort University, Leicester, United Kingdom

Abstract

Risk factors for cardiovascular disease including diabetes have seen a large rise in prevalence in recent years. This has prompted interest in prevention through the identifying individuals at risk of both diabetes and cardiovascular disease and has seen increased investment in screening interventions taking place in primary care. Community pharmacies have become increasingly involved in the provision of such interventions and this systematic review and meta-analysis aims to gather and analyse the existing literature assessing community pharmacy based screening for risk factors for diabetes and those with a high cardiovascular disease risk.

Methods: We conducted systematic searches of electronic databases using MeSH and free text terms from 1950 to March 2012. For our analysis two outcomes were assessed. They were the percentage of those screened who were referred for further assessment by primary care and the uptake of this referral.

Results: Sixteen studies fulfilled our inclusion criteria comprising 108,414 participants screened. There was significant heterogeneity for all included outcomes. Consequently we have not presented summary statistics and present forest plots with I² and p values to describe heterogeneity. We found that all included studies suffered from high rates of attrition between pharmacy screening and follow up. We have also identified a strong trend towards higher rates for referral in more recent studies.

Conclusions: Our results show that pharmacies are feasible sites for screening for diabetes and those at risk of cardiovascular disease. A significant number of previously unknown cases of cardiovascular disease risk factors such as hypertension, hypercholesterolaemia and diabetes are identified, however a significant number of referred participants at high risk do not attend their practitioner for follow up. Research priorities should include methods of increasing uptake to follow up testing and early intervention, to maximise the efficacy of screening interventions based in community pharmacies.


Introduction

Globally, the prevalence of type 2 diabetes (T2DM) and risk factors for cardiovascular disease (CVD) have seen an upward trend in recent years [1]. Although independent conditions, these diseases can be classified as ‘lifestyle’ related diseases as they share a number of common modifiable risk factors such as obesity, hypertension and low physical activity levels. Prevention, diagnosis and treatment of these two diseases require approaches which take into consideration the overlap in risk factors. It was estimated that in 2011, 366 million people were living with diabetes worldwide [2]. More worrying still is that the incidence of diabetes is increasing dramatically and 50% of people living with the condition are currently undiagnosed [2]. Conservative estimates suggest that diabetes accounts for a total worldwide healthcare expenditure of 465 billion dollars [2] increasing to 561 billion by 2030 [3].

In 2006 CVD was the primary cause of 17.3 million deaths worldwide and like diabetes, this is expected to rise dramatically to 23.6 million by 2030 [4]. The increasing prevalence of T2DM and CVD has seen increased healthcare expenditure focusing on disease detection and early intervention to delay progression and the onset of complications. In both the United Kingdom (UK) and in the United States (US), guidance has been introduced to encourage vascular risk assessment including T2DM risk in adults aged 40 and above. Economic evaluation has shown that screening for T2DM is cost effective and may be cost saving from a health system perspective [5]. It is estimated that population based screening for cardiovascular disease in the UK alone will a
simple risk score incorporating routine data in 60% of the population could prevent up to 36,709 events annually [6].

The vast majority of research in this area thus far has focused on practice based screening to identify high risk patients to invite for testing. A number of simple risk assessment tools have been developed to pre-screen large numbers of individuals and target high risk individuals with invasive blood tests [7]. Although successful in detecting cases of undiagnosed diabetes, screening at locations such as GP surgeries could have the potential to widen health inequalities. Current screening interventions offered through GP’s are associated with lower levels of uptake in BME groups and those from lower socioeconomic groups who are known to suffer from higher rates of lifestyle related diseases such as diabetes and CVD [8].

Community pharmacists are already actively involved in the management of T2DM and CHD and their involvement has shown beneficial effects in patient education and disease management [9,10] [11]. In the context of health screening, pharmacists are known to be knowledgeable specialists but seen as an underused resource within the primary care health team [12]. Community pharmacists are estimated to have face to face contact with around 90% of the population annually [12]. Health screening based within the pharmacy and out in the community represents a valuable opportunity to potentially engage with groups who may be less likely to accept GP based healthcare or be empowered for self-care including the elderly, those from lower socio-economic backgrounds or from minority ethnic groups [1]. Potential increased uptake in hard to reach groups has been demonstrated by one previous UK based programme which found high levels of participation in both males and black and minority ethnic groups (BME) groups [13].

Pharmacists are ideally placed to support existing screening methods by signposting customers to other services run by pharmacy staff for example smoking cessation. Smoking is cited as one factor in reduced health outcomes in groups with higher deprivation [14].

Almost a decade ago the paucity of research in the area of pharmacist initiated disease detection and case finding was identified by a review of the literature [11]. Although there have been a small number of studies evaluating opportunistic methods of pharmacy screening for chronic disease globally. Thus far, there has been no synthesising of this data and no evaluation of the overall success of past screening interventions worldwide.

The purpose of this systematic review is to evaluate current literature focusing on pharmacy based screening interventions for T2DM and CVD. We will evaluate response rates to pharmacy based screening as well as numbers of people either diagnosed or defined as ‘high risk’ by a pharmacy risk assessment or screening test in order to quantify the level of success of opportunistic pharmacy led screening interventions to better inform the design and delivery of future services.

Methods

Data Sources and Searches

We searched the Cochrane central register of controlled trials, MEDLINE and EMBASE databases from 1950 until April 2002. The search strategy comprised of four layers of search terms relating to T2DM, CVD, pharmacy and screening programmes. Keywords and medical subject headings were used to identify papers reporting uptake or yield of screening programmes, with the first phase of screening taking place at pharmacies. No language restrictions were used in the selection of papers. An example of the review protocol and electronic search strategy used can be found in the online appendix. Studies were reviewed at the title, abstract and full text stage by two independent reviewers (AW and PR). Disagreements were resolved through discussion and third party advice from other co-authors was sought where necessary. Authors from the selected full texts were contacted by post and email to provide any missing data relating to the main outcomes considered.

Study Selection

We included studies screening people for either T2DM or CVD, whereby the first contact made between the participant and healthcare professional was in a community pharmacy. We defined CVD screening as either calculation of CVD risk based on a validated scoring algorithm or measurement of blood pressure, lipids or triglyceride levels.

T2DM screening was defined as calculation of diabetes risk based on a validated scoring algorithm or assessment of known risk factors or measurement by a pharmacist of blood or plasma glucose (either fasting or non-fasting), HbA1c, or any combination of the aforementioned methods.

Data Extraction and Quality Assessment

Risk of bias was assessed independently by two reviewers using the US Preventive Services Task Force (USPSTF) Quality Rating Criteria [15]. The process involves evaluating each study based on a number of characteristics including, blinding, drop out, measuring procedures used and appropriate statistical analysis techniques and grading as ‘good’, ‘fair’, or ‘poor’.

Data Synthesis and Analysis

Two main outcomes were assessed namely 1) referral rate to primary care and 2) the uptake to the primary care referral. The referral rate was defined as the number referred divided by the number screened. Uptake was defined as the number attending their general practitioner divided by the number referred.

The log odds of referral were calculated as ln(number referred/ number screened-number referred) with standard error = sqrt(1/number referred + 1/number screened-number referred). Similar formulae were used for the uptake. We also calculated pooled rates for percentage of the screened population who proceeded cut offs for hypertension, hypercholesterolaemia and T2DM. The log odds were pooled using a random effects model to take into account heterogeneity between studies. Outcomes were back transformed by taking exponential and reported as mean referral and uptake rates with 95% confidence intervals. Analysis was carried out in Stata (version 12).

Results

Summary Characteristics and Quality of Included Studies

16 individual studies were included in this review [16-31] (see figure ). In total, 188,414 participants were screened for CVD risk factors including cholesterol, blood pressure and T2DM. Participants screened had a mean age of 54.6 years and 56.6% were females. Seven of the studies were conducted in North America, four in the UK, three in Australia, one in TheNetherlands and one in Switzerland. Five studies reported results following diabetes testing or diabetes risk assessment and 15 of the included studies reported results of CVD risk factor screening (see table 1). 9 studies provided data which was included in the meta analysis [17,20,23,24,26,30]. All 9 studies provided data on percentage of the screened population referred. One paper published by Keanes et al [20] included two trial arms testing different methods of screening. The two methods had differing rates for referral and...
Table 1. Summary of Included Studies.

<table>
<thead>
<tr>
<th>First Author</th>
<th>Year</th>
<th>Quality Rating</th>
<th>Country</th>
<th>Number Screened</th>
<th>%men</th>
<th>%women</th>
<th>Mean Age (years/SD)</th>
<th>Total % referred</th>
<th>Uptake</th>
<th>Exceeded Diabetes cut-off</th>
<th>Exceeded BP cut-off</th>
<th>Exceeded Cholesterol cut-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denny 22</td>
<td>2009</td>
<td>Fair</td>
<td>UK</td>
<td>621</td>
<td>55%</td>
<td>45%</td>
<td>64.1 ± 16</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Earle 23</td>
<td>2001</td>
<td>Fair</td>
<td>UK</td>
<td>263</td>
<td>58%</td>
<td>42%</td>
<td>64.3 ± 14</td>
<td>96%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Edwards 24</td>
<td>1981</td>
<td>Poor</td>
<td>UK</td>
<td>215</td>
<td>56%</td>
<td>44%</td>
<td>64.4 ± 12</td>
<td>65%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Hersberger 25</td>
<td>2006</td>
<td>Good</td>
<td>Switzerland</td>
<td>93,738</td>
<td>64%</td>
<td>32%</td>
<td>60.9 ± 14 (1.1)</td>
<td>90%</td>
<td>72%</td>
<td>NR</td>
<td>6.9%</td>
<td>14.2%**</td>
</tr>
<tr>
<td>Horgan 26</td>
<td>2009</td>
<td>Good</td>
<td>UK</td>
<td>1141</td>
<td>60%</td>
<td>40%</td>
<td>75.1 ± 15</td>
<td>72%</td>
<td>NR</td>
<td>32%</td>
<td>32.0%</td>
<td>29.8%***</td>
</tr>
<tr>
<td>Hourihan 27</td>
<td>2003</td>
<td>Good</td>
<td>Australia</td>
<td>204</td>
<td>71%</td>
<td>29%</td>
<td>44 ± 16</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Ismail 28</td>
<td>2001</td>
<td>Good</td>
<td>USA</td>
<td>201</td>
<td>75%</td>
<td>25%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
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<tr>
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<td>2010</td>
<td>Good</td>
<td>Canada</td>
<td>317</td>
<td>46%</td>
<td>54%</td>
<td>70.9 ± 13 (2.8)</td>
<td>NR</td>
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<td>NR</td>
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<td>NR</td>
</tr>
<tr>
<td>Krasia 30</td>
<td>2007</td>
<td>Poor</td>
<td>Australia</td>
<td>802</td>
<td>74%</td>
<td>26%</td>
<td>NR</td>
<td>28%</td>
<td>90%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Krasibbi 31</td>
<td>2017</td>
<td>Poor</td>
<td>Australia</td>
<td>404</td>
<td>64%</td>
<td>36%</td>
<td>NR</td>
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<td>28%</td>
<td>28.1%</td>
<td>NR</td>
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<td>Good</td>
<td>Australia</td>
<td>640</td>
<td>71.4%</td>
<td>28.6%</td>
<td>NR</td>
<td>72%</td>
<td>87.7%</td>
<td>5.5%</td>
<td>NR</td>
<td>40.0%***</td>
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<tr>
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<td>Good</td>
<td>Thailand</td>
<td>300</td>
<td>NR</td>
<td>NR</td>
<td>46.6 (9.1)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Gaidano 34</td>
<td>1994</td>
<td>Good</td>
<td>USA</td>
<td>375</td>
<td>65%</td>
<td>35%</td>
<td>48.0 (18)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>17.5%**</td>
</tr>
<tr>
<td>Ohmahk 35</td>
<td>2010</td>
<td>Fair</td>
<td>USA</td>
<td>218</td>
<td>72%</td>
<td>28%</td>
<td>NR</td>
<td>4%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>30.5%**</td>
</tr>
<tr>
<td>Madjiski 36</td>
<td>1996</td>
<td>Good</td>
<td>USA</td>
<td>599</td>
<td>65%</td>
<td>35%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>48%</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Hutchinson 37</td>
<td>1979</td>
<td>Poor</td>
<td>USA</td>
<td>106</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Mengoni 38</td>
<td>2003</td>
<td>Good</td>
<td>USA</td>
<td>351</td>
<td>63%</td>
<td>37%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>13.4%</td>
</tr>
</tbody>
</table>

NR = not reported
A & B refers to two study arms from the same two arm randomised trial reporting differing rates for the two main included outcomes.

**Cut-offs Used.**

**Diabetes:**
- Risk factor scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥5.5 mmol/l or random blood glucose ≥11 mmol/l.
- Risk factor scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥6 mmol/l.
- Risk factor scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥8 mmol/l.
- Risk factor scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥10 mmol/l.
- Risk factor scoring method (more than 1 recognised risk factor for diabetes) and fasting blood glucose ≥11 mmol/l.

**Blood Pressure:**
- ≥140/90 mmHg systolic, ≥90 mmHg diastolic.
- ≥150/90 mmHg systolic, ≥100 mmHg diastolic.

**Cholesterol:**
- Total cholesterol ≥200 mg/dl.
- LDL cholesterol ≥130 mg/dl.

*P* values compares: 0.0001 ***P*** ≤0.001 **P** ≤0.01 *P* ≤0.05
uptake of confirmatory testing and were included in the analysis separately. One paper [21] included outcome data from two subgroups, only one of which met the inclusion criteria of an opportunistic method of recruitment. As a result we have excluded participants recruited through a postal invitation from this study. Five studies provided data on uptake of a referral to their general practitioners [20,23,24,26,28,30].

Overview of screening interventions
All except two of the studies were observational [20,22]; both were trials with some degree of randomisation between screening methods. Five of the studies integrated a sequential screening strategy into the study design with the first stage of the screening process being a non-invasive test. In the majority of cases this was done using a risk score or comparison against pre-selected risk factor cut-offs based on age, ethnicity or body mass index. All of the included studies carried out the majority of screening appointments in a pharmacy setting. The majority of screening was performed in a community pharmacy setting. Only one study included a small sub-sample screened during an outreach screening session in a local elderly housing facility [17]. Of the four studies that provided data, mean consultation time was 10 minutes 30 seconds. Generally, the method in which participants found to be at risk were referred to their clinician was poorly reported. The most common form of referral in studies that did provide data was a print out of their screening results and

![Diagram](image-url)
reported prevalence of undiagnosed hypertension. A prevalence of 6% was reported by Mangus et al [17].

Discussion

Overall, our analysis and results show that typically, less than half of people who take part in studies based on opportunistic recruitment to pharmacy screening for cardiovascular disease risk factors are referred to their general practitioner for a follow up appointment. A significant proportion are not followed up or do not attend their general practitioner.

We found evidence of a strong trend towards higher rates of referral in more recently published studies. There was a very high level of heterogeneity for both of these outcomes with values for referral rate ranging from 6.05% to 73.13% and values for percentage take up of this referral ranging from 12.81% to 83.12%. This heterogeneity could have been caused by a number of factors. It is likely that different methods of measurement of uptake to referral accounted for a significant proportion of the variability.

From a health economics perspective higher drop-out rates could increase the cost per case detected from screening interventions [35]. By reducing this drop out a higher screen detected prevalence would be expected, thus reducing the cost per case detected.

The rates reported for the percentage of individuals exceeding diagnostic criteria for hypertension, hypercholesterolaemia and/or diabetes from pharmacy based screening interventions are typically higher than rates for overall diagnosed prevalence of these risk factors. Prevalence of CVD risk factors amongst pharmacy customers is likely to be higher than the general population as a majority will be attending to collect medication for a condition. Data from a UK study [27] included in our analysis showed that baseline values for CVD risk factors such as BMI and blood pressure were all higher in pharmacy customers than in the general population [56].

It is difficult to compare data on referral and uptake with findings from previous literature. Response rates to a postal invitation to a GP based screening programme are generally high [9]. Due to the nature of opportunistic recruitment it is difficult to collect comparable data. Maximising this uptake to pharmacy screening is still of importance however, it may be possible for future screening programmes to collect data that gives an indication of the actual uptake so that this may be compared to other methods of screening.

Comparison is possible between pharmacy and GP initiated screening when considering the percentage of screened participants attending a follow up test. One previous GP initiated T2DM screening intervention reported a 94% uptake of confirmatory testing and 70% of participants completing the screening overall [9]. The substantially lower follow up rates from pharmacy initiated screening are likely to be a symptom of inadequate referral methods between pharmacists and GPs. Development of working relationships between pharmacists and GPs, together with more robust referral methods are necessary to ensure the appropriate follow up of participants identified as high risk by pharmacy based screening.

The finding that more recent studies reported a higher percentage of referrals following a screening appointment is perhaps not surprising. The rising global prevalence of CVD risk factors such as obesity [37], hypertension, hypercholesterolaemia.
advised high risk patients to visit their practitioner. Only four of the included studies provided the clinician with a copy of the results by post or by fax.

Risk of Bias Assessment
Eleven studies were graded as good [17,19,22,30,31], three studies fair [16,18,29] and two studies poor [20,30] using the US Preventive Services Task Force (USPSTF) Quality Rating Criteria [15]. The most common reason for studies being graded as either fair or poor was the quality in describing the screening intervention. Exactly who carried out the consultation in addition to the contact time was particularly poorly reported. The study graded as poor had a high rate of drop out and high levels of missing data.

Percentage of screening population referred and uptake of referral
Significant heterogeneity was found for both main outcomes (p = 0.001). We have therefore presented forest plots showing the two main outcomes reported by the included studies with 95% confidence intervals. We have not presented the calculated summary statistics due to the significant heterogeneity. This is in accordance with previously published guidance [32].

Figure 2 displays percentages of the study population referred to their practitioners. There was a strong trend towards higher referral rates in more recent studies. Figure 3 percentages of the referred population who attended their practitioner. The F statistic showed statistically significant heterogeneity for both outcomes with F greater than 75% in all analyses.

The percentages of individuals who exceeded diagnostic cut off for hypertension, hypercholesterolaemia and T2DM during a pharmacy based test are shown in figure 4 (ii, a and b). Referral cut points for CVD risk factors varied slightly between studies. A blood pressure cut point of ≥140/90 mmHg was used by the majority of studies [17,22,24,26,27]. One study used a cut point based on systolic pressure of ≥160 mmHg [21]. Four studies referred participants exceeding a cut point of 140/90 mmHg [18,28,29,33]. Diabetes cut points of ≥5.5 mmol/L for FBG and ≥11 mmol/L for HbA1c were used by one study [20]. This was in accordance with national guidance from the country in which the study took place [24]. A higher cut point of 8 mmol/L for FBG was used by Osenak et al as a threshold for referral. Cholesterol cut points used were similar between studies, 3 of the included studies used a cut point for total cholesterol of 200 mg/dl [19,25] [31]. Two studies used total cholesterol cut points of 233 mg/dl [23,36].

Prevalence of undiagnosed risk factors for cardiovascular disease
Follow up data from GP confirmatory testing was not routinely reported. Only one study reported data on prevalence of T2DM, impaired glucose tolerance or impaired fasting glucose defined by WHO diagnostic criteria. Knaa et al report 2.1% of the screened population subsequently diagnosed as having either Impaired glucose regulation or impaired fasting glucose based on a fasting or random blood test followed by confirmatory oral glucose tolerance test. The same study reported screen detected prevalence rates of 0.2% and 1.7% from the two trial arms [20]. A screen detected prevalence of previously undiagnosed high total cholesterol of 17.38% was reported by one study, Jafari et al [25]. Only one study
### Pharmacy Screening for CVD Risk Factors

#### Descended

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Figure 4. Percentage of individuals exceeding cut offs by risk factor. I. Diabetes. ii. Hypercholesterolemia. iii. Hypertension.

Appendix four

Pharmacy Screening for CVD Risk Factors

[38] and diabetes [39] would logically lead to a higher number of individuals from a screening population crossing referral thresholds for blood pressure, cholesterol or blood glucose resulting in a larger number of referrals. Increased focus in recent years on the prevention in addition to treatment of lifestyle related diseases has seen the identification of clearly defined pre-diabetic states known as impaired glucose regulation and impaired glucose tolerance. Because of this more patients may be referred with a suspected ‘high risk status’ in addition to being suspected of being undiagnosed with a CVD risk factor.

Strengths/Weaknesses

The main strength of our study was the use of robust search, review and meta-analysis methods to provide an assessment of the past level of success of previous pharmacy initiated screening interventions. We have also identified a key weakness in past screening interventions which is given greater consideration in the design of future studies.

The main weakness of this review and meta-analysis was due to the heterogeneity in selected outcomes. As a result of this, we were unable to calculate and present summary statistics. Research in the area of community pharmacy is sparse, poorly reported and typically of relatively poor methodological quality. It is possible with an increased number of screening interventions in the future which are well evaluated and properly reported, future meta-analysis may have more success in calculating pooled rates which may be of greater use in informing the planning of future interventions.

One other potential weakness in our analysis results from the way in which the outcomes included in the meta-analysis were measured. In general, the included papers were of sound methodological quality; however, both of our main outcomes were themselves not major outcomes in any of the included studies. Subsequently there was variation in the method of measurement used. Preferred method of reporting for this outcome was through direct access to practice based medical records following a pharmacy referral. This method was reported in only two of the included studies [20,24]. Four studies measured referral rates via a questionnaire with three of those questionnaires being filled out by the research participants [16,19,25] and one being filled out by the practitioners to whom the referrals were made. Response rates for these questionnaires varied and were lowest for the practitioner questionnaires (12.8%) and it is likely that such low response rates would lead to significant selection bias in such studies. It could be hypothesised that referred patients who do not attend a referral may be likely to return a questionnaire; percentage uptake of referrals would therefore be higher amongst a sample of participants that did return follow up questionnaires. As a result it is important to consider that the results gained by such questionnaires only apply to the subgroup who returned the questionnaires and not necessarily the total population screened.

The results of this study highlight a need for improvement in the implementation of opportunistic pharmacy based screening programmes in order to minimise the drop out of referred patients. The level of drop out from screening programmes for T2DM and CVD risk factors represents a significant waste of investment. Screening interventions delivered by community pharmacists have the potential to increase ease of access to screening in order to reduce health inequalities particularly in the area of T2DM and CVD.

Conclusion

The findings of this review show that previous studies of opportunistic pharmacy based screening interventions have been successful in identifying a significant proportion of the population, both suffering from and at high risk of CVD or T2DM. We have shown that more recent screening strategies have identified a higher number of high risk individuals referred to their practitioners for follow up. However the review has also shown that a high proportion of those individuals found to be at high risk of CVD or T2DM do not attend a follow up appointment with their practitioners. It is vital that future screening interventions are designed to minimise this drop out in order to maximise both the financial and health related gains from increased investment and interest in future screening interventions in pharmacies worldwide.

Supporting Information

Checklist S1 PRISMA Checklist. (DOC)

Author Contributions

Conceived and designed the experiments: AW KK MG LG. Performed the experiments: LG AW PR. Analyzed the data: LG AW. Contributed reagents/materials/analysis tools: LG AW. Wrote the paper: AW.

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Appendix four

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