Reducing Hospital Attendances for New Vascular Referrals While Improving Risk Factor Investigation

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Reducing Hospital Attendances for New Vascular Referrals While Improving Risk Factor Investigation

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Declaration Form

I declare that this dissertation, which I submit to RCSI for examination in consideration of the award of a higher degree MSc Physician Associate Studies, is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Abstract

Vascular disease is strongly associated with advancing age. As Ireland's population gets older and the prevalence of other risk factors such as diabetes increase so too does the incidence of vascular disease. In an already heavily burdened system it is important that all processes operate efficiently without sacrificing quality of care provided to the patient. A key metric of quality care provision is patient satisfaction. Something which is negatively impacted by repeated hospital attendances. This quality improvement (QI) project plan proposed to reduce the number of attendances new vascular referrals made to the hospital by identifying areas of waste within the current system. A more proactive screening of modifiable risk factors such as diabetes was also proposed. The DMAIC (define, measure, analyse, improve, control) framework as set out in the Lean-Six Sigma QI model was utilised. After stakeholder analysis, process flow mapping and driver diagram production, it was determined that, improving inter-departmental communication and standardisation of triage and investigation ordering were high yield targets for improvement. Patient attendance records and imaging information showed that 39% of new patients were attending without relevant scans. An improved process flow map was proposed which would conservatively see attendances reduced by four, and by creating a standard pathway for imaging investigation see patients receive an improved quality of care when they attend. By liaising with the phlebotomy department and adapting a protocol already in place by another department, risk factor bloods were added to the proposed patient investigation process.

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Chapter 1: Introduction

1.1 Introduction

This chapter provides an introduction to a Quality Improvement Project Plan (QIPP) that was produced for a vascular service at a large Irish university teaching hospital. The project investigated the cause of excessive hospital attendances by new vascular referrals to the vascular outpatient service. In this chapter to add context, the organisation where the project was conducted is described along with an explanation of the rationale for this QIPP and its potential impact. In section 1.4 the aims and objectives of the QIPP are presented, followed finally by a description of the writer's role within this project.

1.2 Description of the Organisation

This QIPP was conducted in a large urban hospital which saw more than 160,773 patients in 2017(1). The out patients department of the hospital saw more than 160,773 patients in 2017(2). There are 3 clinic sessions every weekday across nine clinic spaces. Assuming no clinics were to be cancelled each would have approximately 34 patients. The attendance for the Wednesday vascular outpatients clinic was 61, 60 & 66 patients in the three week period commencing 26th March 2019. This is an academic calculation, as it was not possible to ascertain how many clinics were cancelled, and unrealistic to assume all patients would be divided equally among them. What it does is serve to illustrate the considerable volume through this clinic and rationalise the difficulty this clinic has in seeing all its patients within its three hour window.

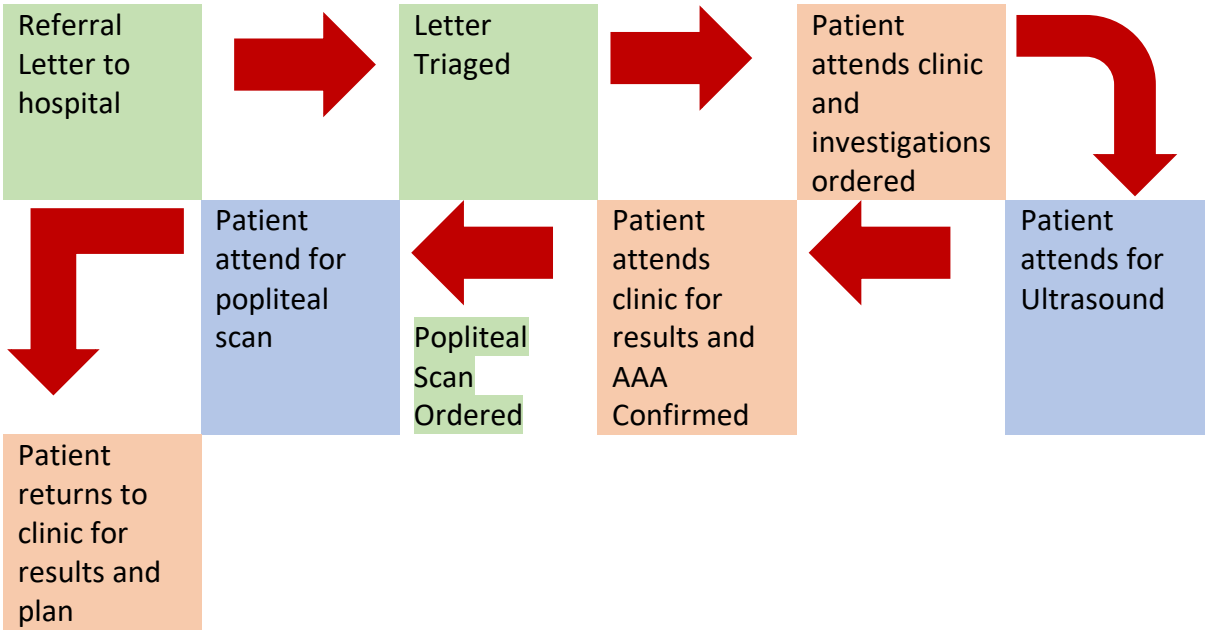
To maximise the diagnostic yield of these vascular clinic appointments patients are required to undergo specific investigations depending on their presenting complaint. This requires co-

ordination between the vascular clinic and the non-invasive vascular unit (NIVU). The NIVU, situated on the ground floor of the main hospital has three scanning suites available for Duplex Ultrasound, Ankle-Brachial Pressure Index (ABPI), Toe Pressures, Walking Distance and venous investigations. It is utilised by both in-patients and out-patients

Situated 5km north of Dublin city centre, this hospital has a local population of 290,000 and a bed capacity of approximately 830. As a hospital within the capital city, public transportation is a key factor in how many patients arrive to the clinic. Studies of patient attendance to outpatient appointments in both the USA and UK show that attendance is lower in areas where public transport usage is higher, specific to screening type appointments.(3, 4) Furthermore, as the number of outpatient appointments increases the tendency for patients to miss appointments also increases.(5)

1.3 Rationale for Quality Improvement Plan

Age is a strong non-modifiable risk factor for vascular disease. Ireland has had a 20% increase in over-65s between the last two censuses.(6) This profile of an aging population implies that the burden on the vascular services in Ireland is due to increase in the coming years. As such it will become increasingly important that the pathway in place for these people is as efficient as possible, both for the sake of the patient and the institution.



Key:

	Individual days patient must attend
	Days which may be separate attendance or on same day as clinic
	Actions Which do not require patient attendance

Figure 1. 1 Pre-Quality Improvement Process Flow Map (Overview)

Figure 1.1 provides an overview of the process in place before commencement of the QIPP. Here once the letter is received and triaged, the patient attends the clinic where they meet a member of the vascular team who will then order investigations based on how their referral was triaged, their presenting complaint, and clinical suspicion . The patient will most likely return at a later date to have this investigation performed by a member of the non-invasive vascular unit. They will again return to the clinic to receive the results of this test. If for instance, an abdominal aortic aneurysm was detected, they would be referred once more to the non-invasive vascular unit to have another ultra sound performed, this time on their

popliteal arteries. They will once more return to the clinic to get these results and a follow up plan will be devised.

There are 681 people on the waiting list for the vascular clinic to be seen in the coming 12 months 496 of whom are scheduled to be seen within three months which is 41 people per clinic. (1) Approximately 20 fewer than what is currently being seen.

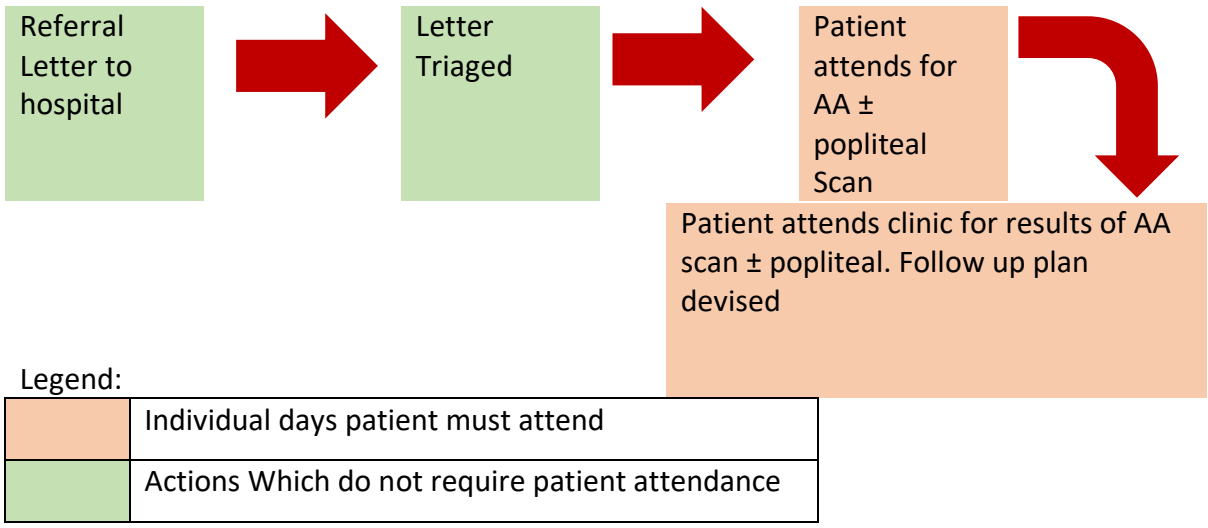


Figure 1. 2 Proposed Post-Quality Improvement Process Flow Map (Overview)

As the overview in figure 1.2 describes, this QIPP proposes that the referral letter is triaged and the investigations are ordered before the patient is seen in the clinic. On first attendance, the popliteal scan is performed along with the abdominal aorta scan at the discretion of the NIVU. The results of these scans would therefore be available to the doctor on the patient's first presentation to the clinic allowing for their follow up plan to be immediately implemented,

reducing their number of attendances while creating more capacity in both the clinic and NIVU.

Additionally it is proposed that new referrals to the vascular clinic attend phlebotomy and be screened for cardiovascular risk factors. Increasing survivability for this cohort and reducing the likelihood of future inpatient admissions with complication of vascular disease.(7)

1.3.1 Impact

Reducing hospital attendances would have a positive impact on the patients in reducing the burden of travel costs, loss of earnings, sourcing childcare, and other financial and social stresses. Reducing hospital visits may also improve their satisfaction with their healthcare as efficiency is consistently seen as an area for improvement in the Irish healthcare system. (8)

Peripheral arterial disease (PAD) and abdominal aortic aneurysm (AAA) investigation are the most common reason for presentation to the vascular clinic. Therefore reducing initial clinic visits before development of a comprehensive treatment plan by up to two visits (66%) also has the potential to significantly reduce the burden on the vascular clinics.

1.4 Aims & Objectives

The first step in a QI plan is to define a clear aim and set of objectives. An effective method to do this is to use SMART goals, that is, Specific, Measurable, Attainable, Realistic, and Time-based.

1.4.1 Aim

The primary aim of this QIPP is to reduce the number of hospital attendances by new patients to the vascular clinic.

The Secondary aim of this QIPP is to provide more proactive management of vascular risk factors by adding laboratory bloods to all new vascular patients first attendance.

1.4.2 Objectives

The objectives of the project are to:

1) Define the problem by discussing with stakeholders and creating a process flow diagram of the patients journey from receipt of referral to completion of initial investigations by the 15th of March 2019
2) Quantify the problem using data from the on-site patient information system and McKesson radiology suite by the 28th of June 2019
3) Produce an improved process flow diagram and develop a plan for improvement of the identified problem areas which can be disseminated amongst the stakeholder by the 2nd of September.

1.5 Writer's Role Within QIP

The writer's role was, in conjunction with their project sponsor to initially garner support and create champions for this project within the involved teams. Identification of these people was achieved through stakeholder analysis. Further utilisation of QIP tools aided the writer in defining the issues and creating a problem statement. Once the data collection phase of the

project began it was the writer's responsibility to ascertain the numbers and demographics of patients that came through the clinic in the defined period. By co-ordinating with the surgical secretaries the writer collated the patient information as it became available on the in hospital patient information system (B.H.I.S.), this was cross referenced with the patients clinical investigation data to generate a master data sheet from which analysis could be performed. Following primary data collection completion the writer was then responsible for its analysis.

Throughout, the writer liaised with all concerned parties, regularly checking in with their sponsor concerning the progress and direction of the project. On completion of the QIPP it is the writer's role to see that it is disseminated to those who can implement it. Generally it was the writer's responsibility that nobody participating was being treated unfairly due to a component of this study.

1.5 Summary

This introductory chapter provided a brief overview of the QIPP contextualising the setting of the project, highlighting its aims and objectives, rationale for being performed, and the role of the author within it. The following chapter will discuss the literature pertinent to this project. After the literature review the methodology of the project is presented detailing the QI tools that were employed to clarify the improvement process. The evaluation of the data generated in chapter three takes place in chapter four in which the QIPP so far is reflected on and its implementation, longevity and dissemination are considered. Finally, in chapter five before final conclusions are drawn the project is discussed in terms of impact, strengths and weaknesses, lessons learned and recommendations for future projects.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews the literature pertaining to extended waiting times and issues occurring with multiple required attendances. Factors relating to modifiable risk factors for vascular disease that may be screened through a fasting blood sample are also reviewed. How this literature review has impressed on the course of the QIPP will also briefly be discussed.

2.2 Search Strategy

A detailed list of key-words and phrases were devised primarily for use with MEDLINE, CINAHL Plus, Health Business elite and LISTA through EBSCOhost. Using Boolean/Phrase searching avoiding smart text searching due to the broad range of results it reported, strings such as "Vascular disease" OR “peripheral vascular disease” OR "peripheral arterial disease" OR PAD OR AAA were created and the then combined using AND with "waiting times" OR "delay" OR “waiting list”, "multiple attendance" OR "attendance fatigue" OR "non-attendance " AND (aaa OR "abdominal aortic aneurysm" OR pad OR "carotid disease"). Results not directly relating to vascular disease or those relating solely to stroke/cardiovascular disease were omitted as were all studies published before 2014. A collection of papers deemed suitable numbering 97 were exported to Endnote X8 citation manager.

2.3 Review of Themes

After reviewing the literature three themes emerged. Extended waiting times, multiple attendances, and vascular risk factors.

2.3.1 Extended Waiting Times

Extended wait times negatively impact on a patient's experience of a health care system.(9) It exacerbates their feeling of illness and has been shown to be the primary cause of poor patient satisfaction in the health service, followed by clinic wait time and clinical contact time. (9-11) This is directly related to feelings of increased stress among staff coinciding with work overload and leads to a reduced quality of service provision.(12) Increased demand, limited capacity and the necessity to invest in error prevention have hospitals worldwide looking to reorganise their healthcare operations and seek answers to the question of how can waiting times be reduced. (13, 14)

Providing clinical context for the effects of extended waiting times in the vascular setting Gocan et al. reviewed the incidence of timely carotid endarterectomy for stroke prevention throughout a network of Canadian hospitals in 2016.(15) While best practice clinical guidelines recommend that symptomatic patients should undergo carotid endarterectomy within two weeks, in this network of hospitals, only 9% of patients achieved that target.(16) This study investigated holistically the patient journey from onset of symptoms through to definitive surgical intervention and highlighted three key areas where there were delays, one of which was a delay in imaging. Quality improvement in time to imaging was referred to as a "stand out target" and has been highlighted as a critical component of patient assessment.(17) Of the 75 patients that met the inclusion criteria for this study 13 experienced transient ischaemic attack events while awaiting carotid endarterectomy.

Waiting lists can be viewed simply as two factors: demand and capacity. If demand exceeds capacity waiting lists would grow into perpetuity. This does not mean that capacity is not

growing necessarily but that demand may be growing quicker. Factors affecting this dynamic may not be as simply broken down. In a situation where queues are long but steady, a steadiness matched by capacity is unlikely to be improved if it is not assumed that there are adequate resources and the stalemate is being caused by organizational shortcomings (18, 19). While this will not always be the case, productivity reports furnished by the NHS show that within the same system consultations completed can vary by up to 100% (20). This would indicate that, were low level performers brought up to an average productivity level there may be a corresponding increase in capacity and reduction in waiting lists. Low level performer does not necessarily refer to an individual but often to an unbalanced skill mix or utilisation within a team (21). Methods commonly touted to improve efficiency and reduce waiting lists by identifying and optimising under-utilised components are the LEAN and the Six Sigma methods or the combined Lean Six Sigma(22) (23).

Outside of industry, in the medical setting however LEAN and Six Sigma are utilised less as a quality improvement method and more as a meeting place for problem solving (2).

The strategy for integrated outpatient services as proposed by Plunkett et al. has eight measures of success of its Promote Health And Wellbeing As Part Of Everything We Do So That People Will Be Healthier objective.(24) Objectives 3: An enhanced referral management system, providing decision support and enhanced access to appropriately-delivered healthcare and 8: Healthcare services that make every outpatient contact count, with risk factor and prevention-focussed interventions recorded in the pathway management component of the integrated referral management system align neatly with the goal of this project.(24)

2.3.2 Multiple Attendances

Multiple attendances negatively impact both patient satisfaction with a healthcare organisation and the ability of that organisation to provide the most efficient, quality care possible. One of the negative effects of increasing attendances is an increase in non-attendance and cancelations.(25) Patient “no-show” decreases the productivity of the organisation and increases time to appropriate investigation for the patient potentially delaying diagnosis and reducing quality of care. (25) Patient non-attendance and cancellation of scheduled appointments is a widespread problem in the provision of medicine and as such as been investigated from multiple viewpoints. There is literature on how it disrupts productivity, safety, revenue, optimal staffing levels, and how if impacts the patient-clinician relationship.(25-27)

A focus of many studies is, the reason given by patients for their non-attendance. Patients reported most frequently that they either forgot, misunderstood or did not realise they had an appointment. Other reasons commonly cited included the financial burden of getting to the hospital, or a dependant in the home that they could not leave.(28) Appointment fatigue then is not commonly self-identified as a reason for missed appointment but would no doubt be an exacerbating factor in all of the given reasons given for it. These studies concluded that the most predictive indicators of a patients’ likelihood to miss an appointment were the appointment interval, age, travel distance and previous missed appointment record.(26, 28) This last point is particularly relevant as for instance if at any individual appointment, assuming all other risk factor for cancellation are a constant, should the patient miss that appointment they are now more at risk of missing future appointments and with each missed

appointment their risk of missing further appointments accumulates. This particular point was investigated by Creps et al. (2017) who reported, on the patient attendance over time.(26) 2039 people were followed over seven clinic appointments in a major university medical centre. It was found that at each repeat attendance the decline in attendance was significant (P=0.0001) and for the seventh appointment attendance was 23% lower than what it had been for the first.

These cancellations delay diagnosis, treatment and generally impede the best possible management of the patient. In the vascular setting, this compounds the already present issue of delay to diagnosis. It has been frequently shown that patients with vascular disease experience a substantial delay in their primary diagnosis.(29) This is partially due to patient education about vascular disease.(30) As a disease that is more common in the over 65 population many people misattribute the initial symptoms, such as pain in the legs while walking, to a normal component of the aging process.(29) Also, the time taken from their first attendance to the time where they have been fully investigated and diagnosed is a common aggrievance of patients. (31)

Investigating how capacity and efficiency in the vascular setting is creating multiple attendance Oriowo et al. reported that in a non-invasive vascular unit (NIVU) over half (54%) of sonographer's time is spent on non-scan related activities, most of which is waiting on patient arrival and performing non-patient related administrative activities. Reducing capacity of the NIVU by reducing the amount of time per appointment available for scanning.(32)

2.3.3 Vascular Risk Factors

Throughout the review of literature concerning vascular risk factors the term “Conventional vascular risk factors” frequently appeared. (7, 33, 34) These were widely reported to be the following; Statin use/ Lipid profile (7, 33-38), Smoking history (7, 34-36, 38), Diabetes (7, 33, 34, 36, 38), and Hypertension(36-38)

As this QIP plan has proposed to improve patient survivability by adding lab screening of specific vascular risk factors before patients first attendance smoking has being removed from further in depth review in favour of those factors which may be screened through phlebotomy, adding Thyroid function tests and a Liver profile which are both easily tested and also shown to be vascular risk factors.(39)

2.3.1.1 Statin Use/Lipid Profile

The correlations between increased saturated fat intake and atherosclerotic disease are well known.(40) The purpose of reviewing this literature is to greater understand the association between saturated fatty acid (SFA) intake and serum lipids and more pertinent to this QIP plan, the correlation between serum lipids and atherosclerotic disease. A longitudinal study of elderly women in Australia, age 65+ showed that there was a significant increase in vascular disease related mortality for women with hyperlipidaemia (P= 0.001) By modifying dyslipidaemia it has been shown, particularly since the advent of statins, that there is a reduction of progression of atherosclerosis across all vascular beds and a reduction in mortality when started early. (41, 42) In patients without clinical cardio-vascular disease but who had peripheral arterial disease, symptomatic or asymptomatic, controlling dyslipidaemia has been shown to slow peripheral arterial disease progression and significantly reduce risk

of major adverse cardiovascular events including myocardial infarction and stroke (P = 0.05). (36, 43) Laghari et al. in a study of the prevalence of peripheral vascular disease at a tertiary care level found that, when measuring all baseline parameters associated with vascular disease, within his cohort raised total cholesterol was singularly significantly raised among the peripheral vascular disease population.(44) Studies suggest that there is value to early identification of dyslipidaemia in the treatment of peripheral vascular disease and the prevention of PVD related complications and major cardiovascular incidents in the future. (43, 45, 46) This supports lipid profile screening for first time attendees of the vascular clinic.

2.3.3.2 Glucose

Diabetes and pre-diabetes are widely reported as risk factors for peripheral vascular disease. (47-49) Smoking in the first world continues to decrease while the incidence of diabetes continues to rise. (50) Diabetes is fast becoming the major risk factor for vascular disease.(50) Diabetes' impact on mortality was reviewed in a 2016 meta-analysis of 21 papers totalling 15857 patients by Vrsalovich et al.. They show that PAD in conjunction with diabetes had a mortality of 37.3% compared with 22.2% of PAD patients without diabetes.(51) The peripheral neuropathy that accompanies diabetes may also be a confounding factor in the initial diagnosis of PAD, due to this insensitivity their burden of disease may actually be greater than the non-diabetic PAD patient.(51) A meta- analysis of the distribution of atherosclerotic disease in diabetic patients (DM) synthesising 151 papers reported that DM patients were approximately thirty three percent more likely to have infra-popliteal disease (P = 0.001). (52) Diabetes also increases the risk of carotid plaques, present in over half of Type 2 diabetics (51%) and 13% of young female Type 1 diabetic patients, significantly higher than what would be expected were that cohort not diabetic (P=0.04). (53,

54). Large fluctuations in blood glucose among type 2 diabetics has also been demonstrated to exacerbate vascular disease, particularly in the lower extremity.(47) Knowing the diabetic status of a new patient provides quality, relevant insight in both assessment of symptoms and plan for management.

2.3.3.3 Liver Profile

Before review of the merits of ordering liver profile and in the next paragraph renal profile is something that is uppermost in the minds of all prescribing clinicians, that is, as the vast majority of drugs are hepatically or renally metabolised, having an indication as to how those organs function is valuable information. This is particularly true for liver function in this instance as statins, which have been heavily referenced earlier are primarily metabolised in the liver.(55) Besides the value added to prescribing there is also diagnostic value in ordering a liver profile for a new patient from a vascular perspective. Non-alcoholic fatty liver disease (NAFLD) is closely related to diabetes with 70 – 80% of diabetic patients also suffering NAFLD. (56) Whether presenting with or without diabetes fatty liver disease is an independent risk factor for vascular disease. (57) Independent of diabetes, NAFLD patients in two separate showed an increased carotid artery intima-media thickness (CIMT) ($P = 0.001$). (57, 58) Man et al. also assessed the correlation between liver enzymes tested in a liver profile and CIMT, univariate analysis showed a positive correlation between serum alanine aminotransferase (ALT) ($P=0.03$) , alkaline phosphatase ($P=0.04$) and increased CIMT.(58) Gamma-glutamyl transferase (GGT) which is linked to a broad array of chronic conditions including vascular disease at increased levels was positively correlated with ankle brachial pulse wave velocity ($P=0.02$). (58, 59) In those with NAFLD and type 2 diabetes, NAFLD was associated with a 75% increased risk of PAD. When intervention is considered

for carotid artery stenosis in the asymptomatic patient benefit depends on low perioperative morbidity. The model of end stage liver disease (MELD) score, a component of which is serum bilirubin, which classically has been used to prioritize transplant candidates may be applied in the prediction of surgical outcomes of hepatically dysfunctional candidates.(60) Literature concerning liver dysfunction and vascular disease deals primarily with the negative synergy of diabetes and fatty liver disease. The usefulness of a prescriber knowing the baseline hepatic function of their patient notwithstanding, the considerable risk for liver dysfunction in a vascular patient merits initial screening of liver function.

2.3.3.4 Thyroid Function Tests

Despite not being listed among the “conventional” risk factors for vascular disease, thyroid function tests (TFTs) derangement and its association particularly to atherosclerotic disease is represented strongly in the literature. Increased CIMT in a sub-clinical hypothyroid cohort (P= 0.004), which was reversible with appropriate administration of levothyroxine has been shown.(61) This indicates that a new patient with no thyroid diagnosis may be at increased vascular risk but that the risk is a modifiable one.

2.4 Implications For The Quality Improvement Plan

While the initial focus of this plan is to improve patient experience and reduce excessive hospital attendance by optimising patient interaction with the vascular service, reducing overall visits, on review of the increased survivability that may be conferred to the patient by adding vascular risk bloods to every new patients initial appointment, it is apparent that this may be the most rewarding quality improvement for the patient. Streamlining their experience

with the hospital is also a valuable improvement benefiting new and returning patients and relieving pressure on the clinicians and everyone who is currently operating inside a heavily burdened system. Optimising the current processes will also be the most labour intensive part of this QIP, particularly as experienced Lean Six Sigma operators have reported the challenges in utilising these tools in the context of the health care system.

2.5 Summary

This chapter reviewed the literature pertaining to patient experience, initially extended waiting lists and then the effects of multiple attendances. Factors relating to prominent modifiable risk factors for vascular disease that may be screened through a fasting blood sample. How this literature review has impressed on the course of the QIP was also discussed.

Chapter 3: Methodology

3.1 Introduction

To perform an efficient quality improvement project that will have lasting results there are several factors to be considered. In the field of quality improvement there are many tools which inform us of these factors. The purpose of this chapter is to report the various methodologies available, which of those were felt suited to this project and the results therewith obtained.

3.2 Approaches to Quality Improvement

The term quality improvement as it is applied to the health sector is concerned with supporting the safe, effective, timely, efficient, equitable and cost-effective provision of care. Many models to implement and measure this exist, most of which have been adopted from the world of Industry. These methods are neither mutually exclusive, being frequently employed in unison or hybrid models, nor are the tools used by these methods specific to the method. Commonly used methods in QI are Lean, Six Sigma, Lean-Six Sigma (a hybrid of the aforementioned methods), The model for Improvement and Total Quality Management.

3.2.1 Six Sigma

Six Sigma is the eldest of the QI methods discussed here having being developed by Motorola in 1986. This methodology explores where errors occur in a system and focuses on improving the process to reduce errors.(62) To reduce errors to a six-sigma level is to reduce mistakes to 3.4 per million opportunities, a 99.99966% success rate. To contextualise the difficulty of achieving six-sigma defects per million opportunities (DPMO) in health care consider bile duct injury in laparoscopic cholecystectomy, thought the most dreaded

complication of a common surgical procedure. This injury occurs at a rate of approximately 95 DPMO (5.25 sigma). Were the commercial aviation industry to operate at 5.25 sigma there would be 20 commercial plane crashes per day in the United States alone.(63)

3.2.2 Lean

Lean is a QI process which was first developed in the automotive industry. Toyota developed lean thinking in 1990 as a continuous cycle of improvement which starts by identifying areas of waste within a process and removing them so as to add value to the customer or in the case here, the patient. According to the Pawley Lean Institute there are five main principles of Lean: specify value from the viewpoint of the patient, identify those steps in the value stream and eliminate steps which do not create value, make the steps flow together smoothly towards the patient, once waste has been removed from this activity look at how patients view the next upstream activity and begin this process again until perfection is reached.(23)

3.2.3 Total quality management (TQM)

TQM is a QI methodology which aims to continuously improve the quality of products and processes in order to meet or exceed the patient's expectation.(63) It states that quality is the responsibility of all those involved in the delivery and use of the services, from management to the workforce, suppliers, and even the patients themselves. This philosophy of QI promotes the engagement of everyone affected by the process, highlighting the positive effects of 'buy in'. This method has largely been subsumed by the Lean methodology.

3.2.4 Lean-Six Sigma

While developed separately the processes described above can be applied synergistically to achieve the goals of a QI project. Probably the most widely known product of this synergy is the Lean-Six Sigma method. Lean-Six Sigma often utilises the first of the tools which will be discussed in this chapter, a five-step framework known as DMAIC (Define, Measure, Analyse, Improve, Control). This method benefits from the cyclically improving nature of Lean and the strict statistical analysis of Six Sigma and has been shown to provide better outcomes than either of its component parts in isolation. (64)

3.3 Rationale for Chosen Methodology

Given the clearly defined benefits of Lean-Six Sigma and the operational structure provided by the DMAIC framework therein, this QIP plan has been conducted using the Lean-Six Sigma methodology. This is particularly suited to this project as its focus is on a complicated multi-step process involving multiple departments within the hospital, finding which steps in the process can be improved upon and providing clear data to make evident the positive impact of this project to everyone involved. This is particularly relevant to this QIP as initially the benefit may be seen at a point downstream from some of the people vital to effecting the positive change. This framework provides tangible proof of positive change increasing the likelihood that it is maintained.(64)

3.4 DMAIC

The DMAIC framework, as visualised in figure 1 is a key feature of Lean-Six Sigma, a stepwise process that begins with the Define phase. Here the requirements and expectations of the customers are to be defined along with the boundaries of the project and the process by which the current model runs. At the end of the define phase there should be enough information to identify where within the process there is waste and where the high value targets for improvement lie.

Figure 3. 1 DMAIC flow

With this stage complete DMAIC moves on next to the Measure phase. Using the information gleamed from the define phase to highlight potential area of improvement the measure steps purpose is to gather data that can be later analysed to provide greater, tangible insight in to the areas of waste within the process. It is important here to be thorough in devising which measurement strategy will be used so that data collected reliably informs the question asked. Following measurement, logically is the Analyse phase where the data collected is analysed to determine causes of defects and sources of variation. Determining the sources of variation in the process more clearly instructs as to which areas may be high yield for positive impact on the patient's experience. The goal of the Improve phase is to generate and implement solutions that will remove the causes of problems, decrease the variation in a process, or avoid a problem from recurring. Ideas need to be developed surrounding the removal of the root causes, testing of solutions, and standardisation of the solutions which have been

measured. Once the improvements have been implemented there must be a process implemented to Control and document ongoing performance. without this there will most likely be a backslide in to the previously established, less efficient/ lower quality delivery of service previously employed. In this phase it is important that those operating within the system are impowered to make positive changes where identified beginning the cycle of quality improvement again.

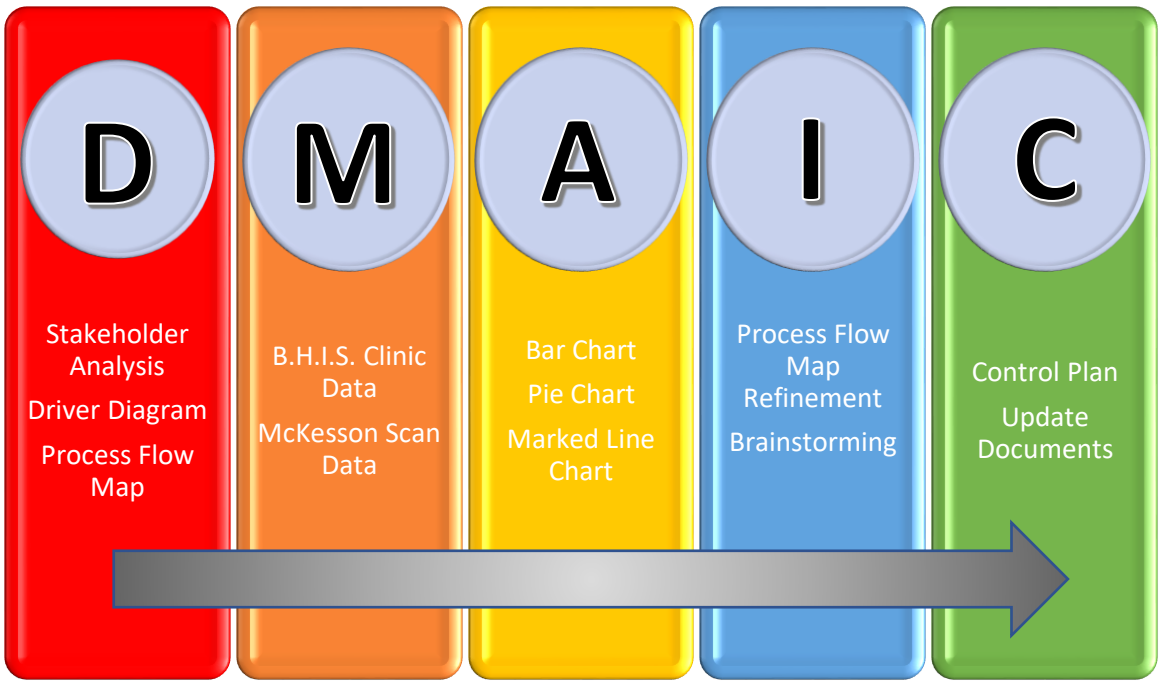


Figure 3. 2. DMAIC tools utilised

3.4.1 Define

In the provision of care for new patients attending the vascular clinic the purpose of this quality improvement project plan must be clearly defined. Firstly, the area within the process that is to be improved needs to be distilled into a clear problem statement. That is, patients with suspected peripheral arterial disease (PAD), Abdominal Aortic Aneurysms (AAA) or carotid stenosis, new to the vascular clinic are required to attend the hospital too frequently in the process of their initial diagnosis. Having established the problem statement the proposed purpose of this QIPP is to, reduce the number of hospital attendances to the vascular clinic by newly referred patients with suspected PAD, AAA or carotid stenosis. By defining these statements, before proceeding into the minutiae of potential wasteful areas and opportunities for error in this system, there is an increased clarity of purpose for both the author and everybody invested in seeing this improvement.

3.4.1.1 Stakeholder Analysis

The stakeholder analysis and generation of a process flow map are two steps which happened in unison. These two tools were the first to be used from the DMAIC framework (fig 3.2). As stakeholders were identified and engaged their insights into the patient's journey from initial referral to development of care plan informed the process flow map (fig.3.4) as the process flow map became more detailed and accurately reflective of the actual processes happening in the hospital, the accuracy of the stratification of stakeholder's power and interest was also improved.

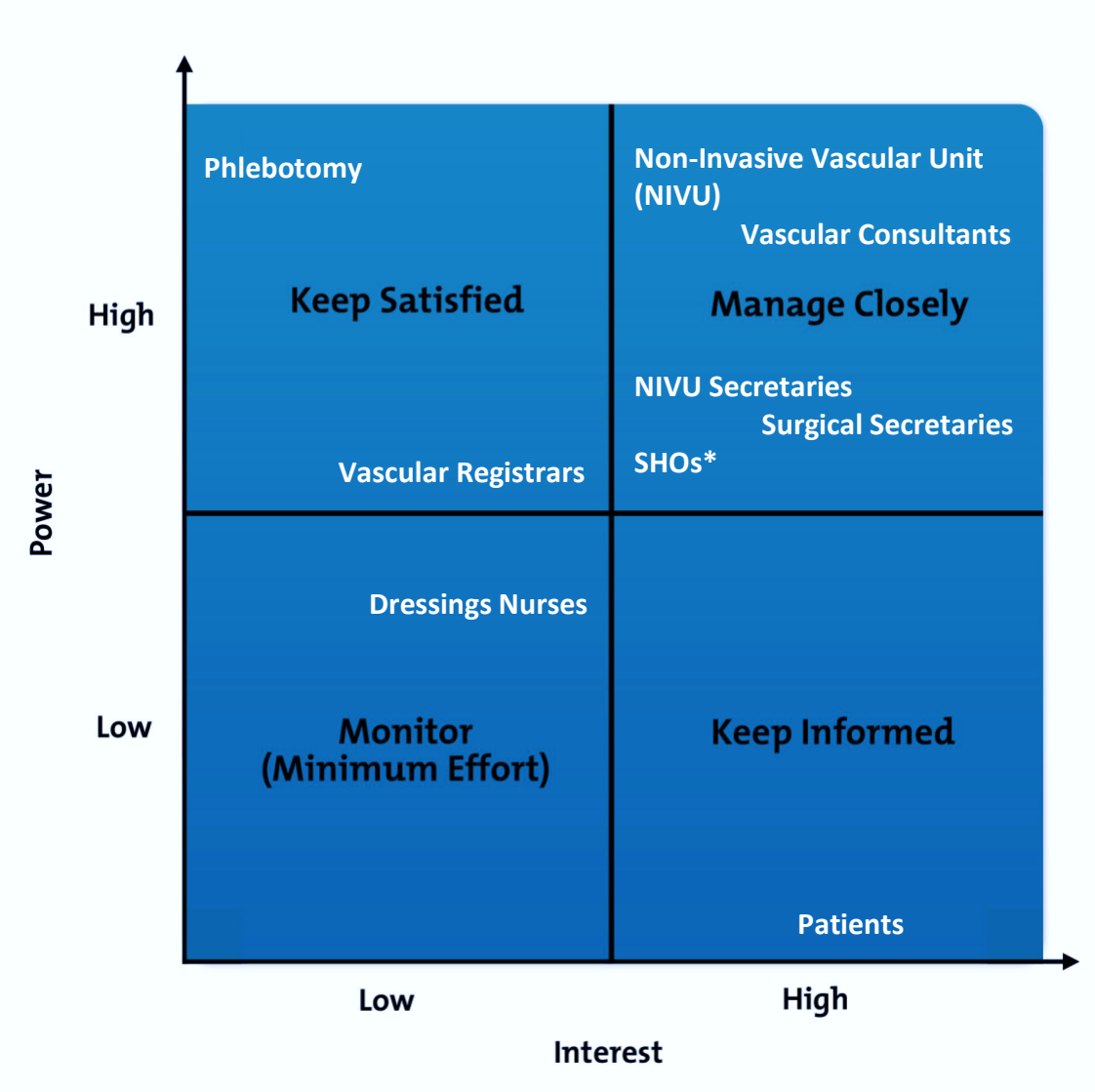


Figure 3. 3 Stakeholder Analysis * = senior house officers

The stakeholder analysis is vital to the implementation and longevity of any proposed improvement project.(64) By assembling a team with expertise in the area, high yield areas of improvement are more readily identified. As can be seen in fig 3.3 a number of high interest, high power stakeholders were identified. These people were contacted at an appropriately early stage in the project development with a view to balancing their likely interest in helping define and implement this QIPP with having a clear view of the purpose and likely outcomes of this QIPP. As in any progressive institution there are many QIP

happing in parallel, some competing for resources. The resource being specifically referred to here is peoples time. Within a QIP people want a certain sense of ownership over the change being implemented but this has to be balanced with the amount of time they must put in to the change to see improvement. With so many stakeholders in the highest influence category, how they are made a part of this team for improvement was key. These were the vascular consultants, NIVU physiologists, NIVU secretaries, surgical secretaries, senior house officers (SHOs) (the medical grade between intern and registrar).

First among recruited team members there needed to be a project sponsor. The vascular consultant who proposed the area having room for a quality improvement agreed to sponsor this QIPP. Having someone who is both highly interested in the topic and from the highly influential bracket in a leadership role provided a strong starting position from which to advance the QIPP.

From initial discussions with the project sponsor likely key stakeholders were discussed and a provisional analysis matrix was developed. On speaking to those stakeholders about where they viewed themselves within the QIP and their views on the best methods of execution for the project further stakeholders were identified and their place in the analysis matrix was refined. The NIVU was identified from early on as one of the key stakeholders in the project both the NIVU secretaries and physiologists work within one of the four key geographical areas in the patient's journey, discussed under process flow. Their involvement would be crucial to the success of this QIP. As one of two reasons for patient attendance in the current process developing a positive relationship would be key to both further understanding the patients journey and finding the highest yield solution, beneficial to all parties. In discussing the current process with the NIVU the variability of the stakeholder's roles within from patient

to patient, week to week was first alluded to and the interconnectedness of the NIVU and surgical secretaries.

Surgical secretaries are responsible for booking clinic appointments while the NIVU secretaries are responsible for booking the various scans that these patients need. The importance of clear communication between these two groups was self-evident. If for any reason a patient needs to cancel or not attend a NIVU appointment it would then be more likely that they would attended a clinic appointment without relevant scans reducing the clinical relevance of that attendance, potentially necessitating an additional clinic appointment.

While these scans are booked by the NIVU secretary they must first be ordered through McKesson. At the time of this QIP this was newly been performed by the SHOs to each respective vascular consultant. Considered to be of high power but of lower interest were phlebotomy and vascular registrars. These people have the ability to affect the ideal outcome of the project greatly but will be less effected by the project than those in the aforementioned quadrant. As such it is of substantial importance that the QIP be viewed in a benevolent light by these people.

Patients were assigned to the low power, high interest group as the intended primary beneficiaries of the success of this project both in terms of patient satisfaction and reduced mortality. However, as this QIP intends to reduce waste in the process which delivers value to them and they enter the process downstream they have little ability to effect change within this process.

Dressings nurses occupy one of the clinical rooms during clinic, while they are present in the clinic and the prospect of a reduction in clinic size may have an impact on their practice. No change in how they operate is foreseen. As a part of the clinic day team it was thought wise to keep them in the loop of what was happening within the team as a whole but ultimately as a non-affected team member they were considered to be in the low interest low power group.

3.4.1.2 Process Flow Map

A frequently used QI tool in healthcare, process flow maps are ideal for identifying areas of waste or duplicated effort. (22, 65) They are of most use when developed by a team of people from the component parts of the system who understand the interconnectedness of the process. In the initial stages of a project a simpler high-level map can be useful as an overview before a more in-depth analysis of the system where the change is taking place is performed. An example of this can be seen in chapter one where the broader process is mapped mostly from the perspective of the patient. This high-level map requires someone who is familiar with the overall process being mapped. In this instance the project sponsor was that person.

For the purposes of identifying the links in the chain most ripe for improvement a more in-depth analysis of the process was required. fig. 3.4 shows the pre-improvement process flow from the point of a new referral letter being received to the point where the new patient has been fully investigated. As mentioned previously this map was generated with the input of those stakeholders primarily from the high interest, high power group. In the current system the Vascular consultant triages each letter and writes on that letter whether they are a

suspected Veins / PAD/ Carotid presentation, determining what scanning they need and whether they are considered urgent or routine. Urgent patients are to be seen within three months. Patients with venous disease are seen in a different hospital and are outside the scope of this project. If PAD or carotid, the letter is returned to the surgical secretary who books a clinic appointment for that patient using in-hospital patient information directory system and an appointment letter is sent to the patient. The patient attends the clinic where a registrar or consultant sees them and orders appropriate scans using McKesson and a repeat clinic appointment for their results, an appointment letter is sent out. At the time of booking the repeat appointment the registrar does not know when the next scan is available.

The NIVU preform a secondary vetting (appendix A) to decide where within the initial triage window the patient lies, for instance if someone was triaged as urgent, requiring scanning in 0-3 months the NIVU vetting decides if that should be as soon as possible or closer to three months. Once triaged the secretary books in the patient for the next available day to be scanned and an appointment letter is sent out. Providing the patient has had their scan before their next appointment they return to the clinic for their results, depending on their scan and results e.g. were they suspected of having an AAA and that was shown to be the case they would be required to go through this cycle once again to be screened bilaterally for popliteal aneurysms. Taking the presumed patient above as they return once more they may be making their sixth hospital attendance before their reason for referral has being fully investigated. In the generation of this process flow map it was pointed out that while this is a possibility for patients that when these appointments are being booked the secretaries are taking it upon themselves to avoid this where possible but that there is no defined protocol to ensure it. As seen in the legend accompanying this process flow map, nodes that would later be removed or altered in the proposed process flow map are colour coded.

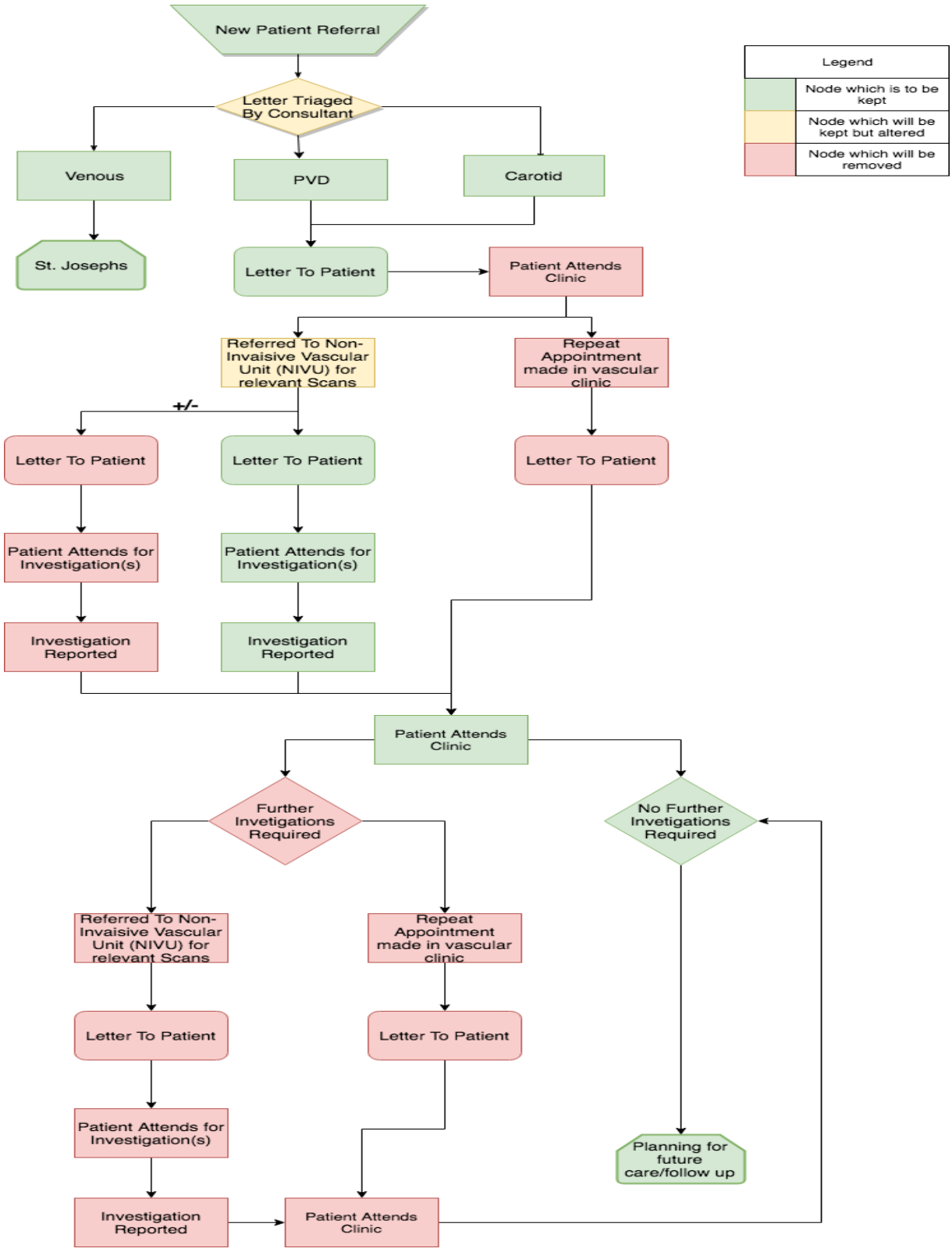


Figure 3. 4 Pre-Improvement Process Flow Map

3.4.1.3 Driver Diagram

Driver diagrams are useful tools in complex operational processes they allow mapping of theories of cause and effect. Considering the multidisciplinary nature of diagnosing and managing a PAD or carotid patient, generating a driver diagram provides greater clarity on what change within the system will reap the most positive rewards. The driver diagram helps break down the high-level problem/purpose statement in to the primary drivers of that problem, the factors which are influencing those drivers and provides a forum where potential interventions can be generated and mapped. This driver diagram (fig 3.5) was generated by gathering the relevant stake holders and in concordance with the process flow map picking out the points that this project needs to influence to achieve its target.

The primary drivers were identified as not having the capacity to scan every new patient who is due to attend the clinic on the day of that clinic appointment and breakdown in communication or non-existing pathways of communication creating low yield clinic visits and repeat attendances. Factors affecting capacity were distilled down to three secondary drivers. One of the three scanning rooms is permanently reserved for inpatients, including during the three hours on a Wednesday (every second Wednesday bearing in mind the one vascular consultant's clinic where this was considered) when the clinic is being held. Each scan is afforded a 30-minute slot to allow for scanning of complex cases but generally is more time than required. That as Ireland's older population increases and the prevalence of diabetes and heart disease rise so too will the number of vasculopaths requiring scanning.(6, 38, 49) Regarding factors affecting the other primary driver, there it is not clearly defined who should order scans, time between letter triage and scan being ordered and whether clinic appointment or scan appointment should be made first. These scans generally are booked

by different people on different systems and not everyone is proficient in both systems. Although most do, not every patient gets the same scans based on how they are triaged.

Looking at these primary and secondary drivers with a view to generating an intervention list. It had to be accepted that factors such as increasing age are impossible to control and that as heart disease and diabetes are both vast issues and both focuses of the HSE anyway that targeting these would neither be achievable nor measurable within the timeframe of this project. Recommendations at least could be made with regards to the other drivers of imaging capacity and also the possibility of people within the process acquiring proficiency in both the patient information system (B.H.I.S.) and McKesson radiology suite. Improving the pathway for scheduling and triaging of the scans is a specific, measurable, achievable, relevant and time-appropriate goal for this project.

Figure 3. 5 Driver Diagram

3.4.2 Measure & Analyse

The tools of the define phase helped to highlight specific areas within the process where there was likely to be waste and points where the risk of miscommunication was the highest. Based on that information and after consulting with the project sponsor and key stakeholders a data collection plan was devised. The primary aims of this section are to firstly quantify the problem and secondly analyse this data to guide the improvement plan. As to follow new patients journeys along the process could take months it was decided that it would be expedient to look retrospectively at the attendance history of people who were attending the clinic both in the patient information directory and McKesson. This allowed key metrics of their journey through the system to be extracted, synthesised and analysed giving a measurable picture of their experience.

In the preliminary stages of this project clinic size was recorded for three clinics in September 2018 the average clinic size across these three clinics was 58 people. Using that figure it was calculated that approximately 1508 people will pass through this fortnightly clinic in a year. Using Cochran's formula for ideal sample size modified for a smaller population and a 95% confidence interval it was determined that the ideal sample size for 281 patients.(66) This would require a data collection phase of ten week and was ultimately considered to be excessive given the time frame of this project. Instead a time frame of five weeks for data collection was adhered to. In these five weeks data form 188 patients was collected. Which when reinserted back in Cochran's formula gives a predicted confidence interval of 87.7%.

3.4.2.1 B.H.I.S.

All patients attending out-patients department have their clinic attendance information held on B.H.I.S. To access that data, it was first necessary to become proficient in using the system. As B.H.I.S. is a MS-dos style keyboard command only system it is non-intuitive and a tutorial session with the surgical secretary was required. Once trained on this system it was possible to ascertain patient demographics (Table 3.1) gender, age, clinics attended, appointments missed/cancelled and new/return/dressings status as well as overall clinic size for that day.

3.4.2.2 McKesson

To find which scans each patient had and whether they had them on the before, day of, or after attending the clinic it was necessary to use the McKesson radiology station, a familiar programme used day-to-day on the hospital wards. Within McKesson the number and type of scan that each patient received could be correlated with the corresponding B.H.I.S. information.

3.4.2.3 Patient Demographics

N=188	PAD (n= 96)	Carotid (n=23)	AAA (n=37)	*Mixed (n=28)	Veins (n=4)
Age (Range)	65.7 (18-91)	73.6 (29-85)	73.8 (47-90)	59.3 (28-84)	52.5(41-74)
Male	61	17	32	16	3
Female	35	6	5	12	1

Table 3. 1 Patient Demographics: *mixed category is made up of patients who have either attended for scans suggesting a mixed aetiology or have no record of being booked for any investigation

The majority of patients in this study were males (n= 129), over 65 (n= 127) with PAD (n= 96) Across all definitive diagnosis the average patient age was over 65 (table 3.1). The mixed

category represents patients who had been booked for a clinic appointment but had either a mixed presentation of vascular or had no history of investigations ordered. This made it impossible to delineate their reason for attending the clinic from B.H.I.S. or McKesson. >85% of these patients were new patients to the vascular clinic the remaining <15% were made up largely of dressings patients. Patients with suspected venous disease as previously stated are investigated off site and were not further considered. The age profile and preponderance of males in the PAD, AAA, and Carotid is in line with that seen in other studies concerning vascular disease.(33) The mixed group being younger and more closely gender balanced may be due to this group having a greater number of first-time referrals and without scans their appropriateness for the vascular clinic may also be questioned.

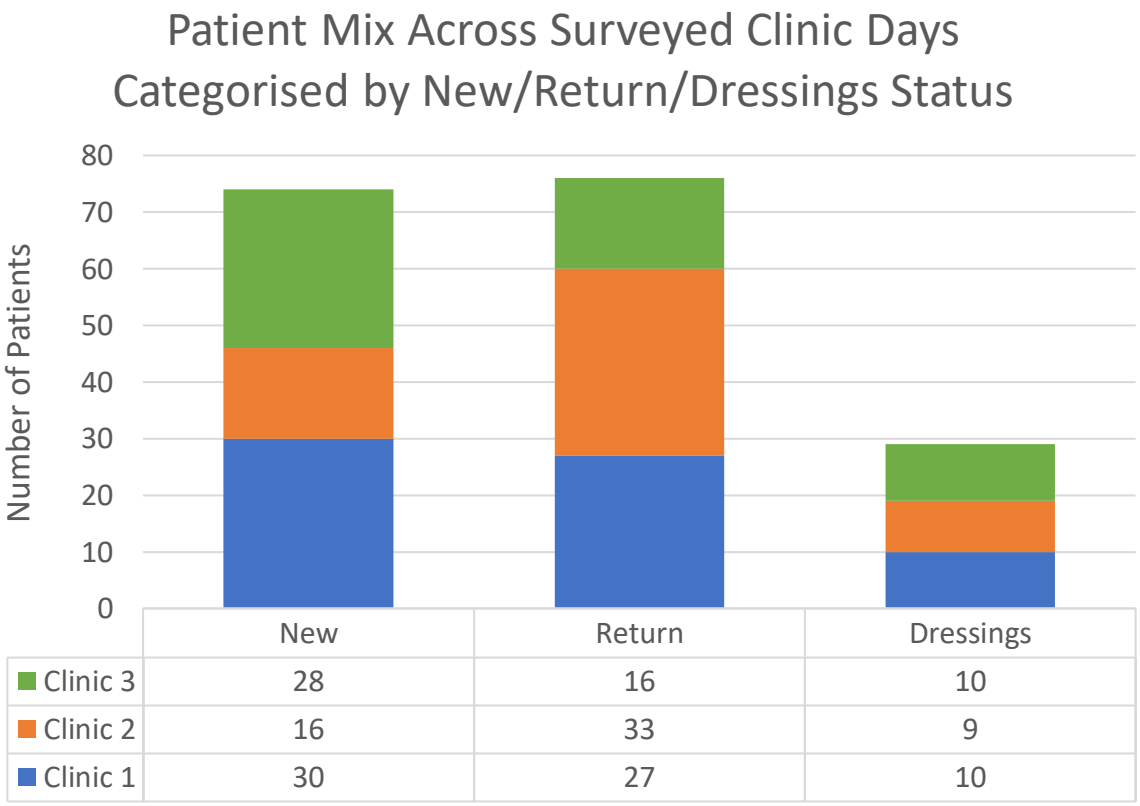
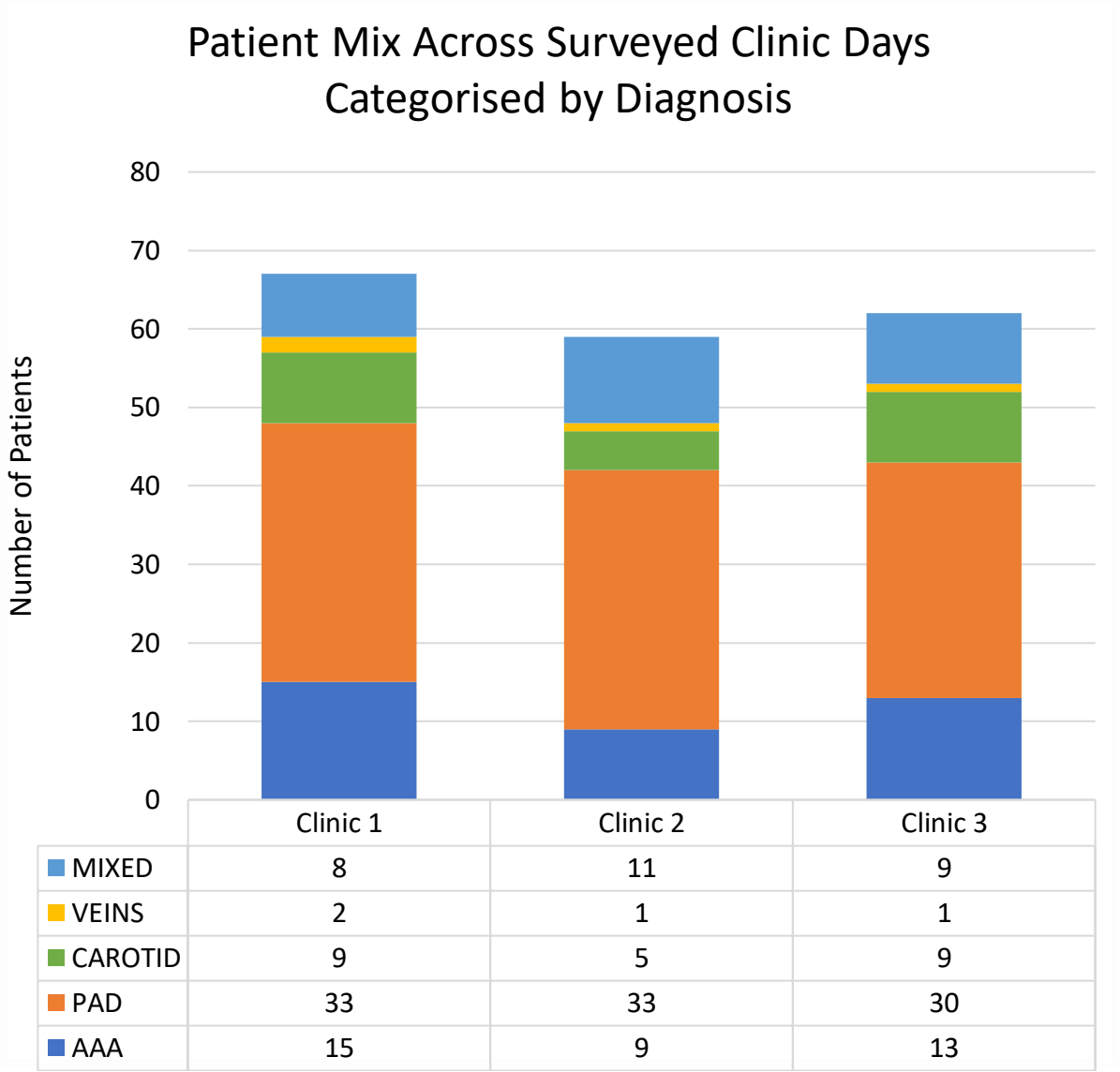


Figure 3. 6 Patient Mix Across Surveyed Clinic Days Categorised by New/Return/Dressings Status

The patient type across the observed clinics (fig. 3.6) provides evidence for the high yield potential of improving efficiency of the clinic by improving the flow of new patients. In two of the three observed clinics ‘new patients’ was the largest group. Overall there were more return patients than new patients, this tracks with the current process flow map (fig. 3.4) which has every person who will attend the clinic as a new patient once potentially attending twice more as a return patient before there preliminary work-up is completed. What can also can be seen is the relatively low yield for improvement of the overall process by targeting the dressings patients.

Analysing patient mix by diagnosis (fig3.7) it is immediately clear that PAD followed up by AAA constitute the largest part of the clinic. This is particularly relevant as both of these groups generally require a greater number of scans than the carotid group (Fig 3.8). It is also worth noting that the small number of veins patients that are present should according to the current process should not be attending these clinics.



	Clinic 1	Clinic 2	Clinic 3
MIXED	8	11	9
VEINS	2	1	1
CAROTID	9	5	9
PAD	33	33	30
AAA	15	9	13

Figure 3. 7 Patient Mix Across Surveyed Clinic Days categorised by diagnosis

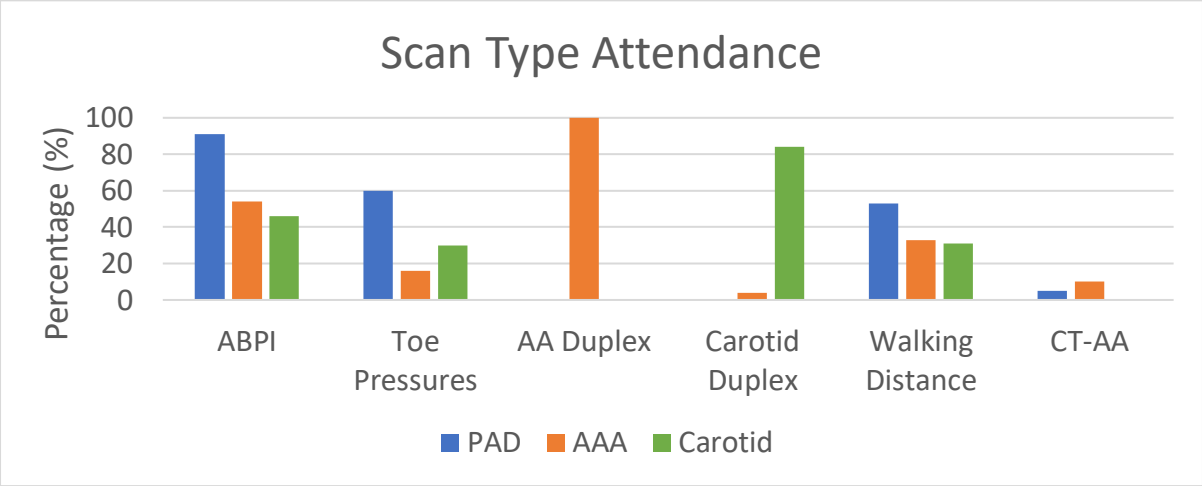


Figure 3. 8 Scan type attendance by diagnostic grouping. Each bar represents the percentage of people who have at least one attendance for each corresponding scan.

Examining scan type attendance by percentage (fig 3.8) it is worth noting the percentage of patients in the 40–60% range and the 80-100% range. The former would suggest a variability in ordering a non-standard test. Or at least that this is an investigation regularly worth performing but not routinely performed. The term performed is used as opposed to ordered as this chart is a tabulation of performed investigation and does not definitively correlate with ordered tests. It is possible that these scans were ordered but not attended cancelled or that they were not ordered. The higher percentage range, that is >80%, would suggest investigations that are the standard investigation for a patient triaged as such. However, only 84% of Carotid patients had a carotid duplex scan. This may be due to them having received another type of carotid scan such as CT-Angio or MR-Angio, there is also the slim possibility that they had their scans performed elsewhere and were not available on McKesson. On looking specifically at the 16% who were seen to not have had a carotid duplex scan, none of them had either a CT or MR-Angio and all but one of them were a new patient to the

vascular clinic. This would suggest that these patients who had been triaged as Carotid patients would most likely attended clinic without their scans and move in to the slower stream of the pre-improvement process flow map.

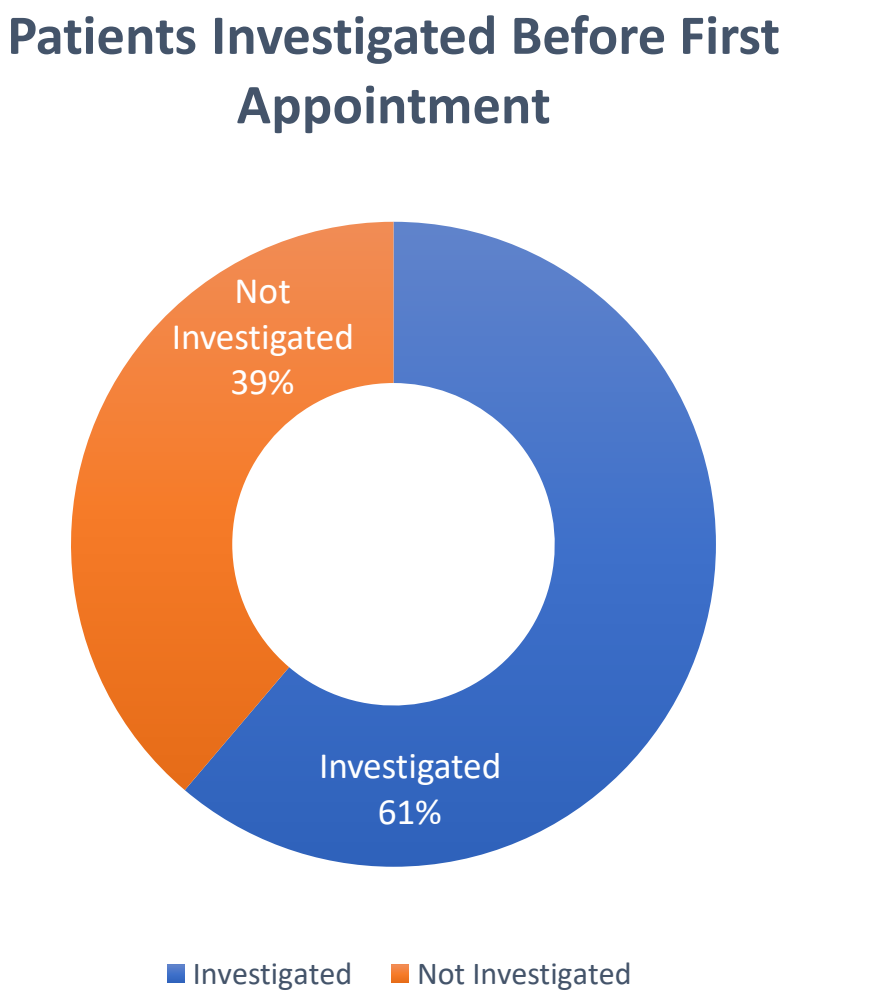


Figure 3. 9 Percentage of New Patients Investigated Before Their First Clinic Appointment

The data for the new to clinic patients across the three clinics observed (n=74) is reported in figure 3.9 in terms of which percentage of patients attended their first clinic with a reported scan. Numerically, 45 attended the clinic with a reported scan in the McKesson suite the other 29 potentially moving in to the slower stream mapped in the pre-improvement process flow

map. Considering the data collected there is agreement between what is seen in the numbers and what was proposed within the define section. Namely that by formalising a protocol by which new referrals are triaged, investigations ordered and booked, clinic appointments booked and different areas of the hospital co-ordinated that there will be an improvement to the process, felt by the patient without detrimental effects to any other ongoing processes.

3.4.3 Improve

The fourth stage of the DMAIC framework is improve. This begins by brainstorming with the team generating as many possible solutions to the problems previously identified. Then as a team refining these solutions to those that most closely align with the SMART objectives of the project. With the best creative alternative(s) selected the implementation strategy of that alternative must be developed. As this team was the same one consulted with during the generation of the pre-improvement process flow map (fig 3.4), the generation of an ideal process flow map was considered an appropriate starting point for improvement.

3.4.3.1 Proposed Process Flow Map

Figure 3.10, the proposed process flow map contains twelve fewer nodes than the current map. There are however two new nodes, highlighted in green, on this map versus the old one. Where the senior house officer (SHO) orders scans has been added as a definite step only in this map as it is not an explicitly defined step in the pre-improvement process. At the time of this QIPP it is a role being performed by the SHOs, however, in the recent past they were ordered by a member of the NIVU team. That the responsibility for the task was never clearly defined led to the creation of a backlog during annual leave and the SHOs being requested to perform this task since. The second added node is the addition of laboratory

bloods being performed on the morning of clinic. This step was suggested by the project sponsor and as discussed in the literature review is the change most likely to positively benefit patient survivability. The addition of this step adds another department to an already multi departmental team. This added layer of complexity could be considered a potential challenge but given the significant aforementioned improvement this change can make to the patients it was felt that overall, the step added value.

Considering the nodes which have been removed from the map, their removal can largely be put down to two improvements, a definitive procedure for ordering specific investigations based on triage category and increased communication between departments to ensure that these scans are performed on the day of, or at least before the clinic appointment. Also key here is removing an element of clinical bureaucracy and affording responsibility to the vascular physiologists to decide whether the patient requires additional scanning and if there is time to perform those scans there. The most obvious example where this change could provide a benefit would be during an AA duplex scan. During the scan the vascular physiologist delineates the margins of the AA, this measurement is the figure used by the vascular surgeon to decide if additional popliteal scans need to be performed. With a clear clinical protocol in place which clearly states that should a AAA be detected a popliteal scan is mandated a clinic attendance for the patient could potentially be avoided. This could be misconstrued as an increased workload for the NIVU but in reality, there would be an increased efficiency and output with no extra work added. This patient would have to be scanned again anyway and that scan would be based on the NIVU physiologist's clinical judgement. Performing all investigations at once frees a second appointment, increasing capacity.

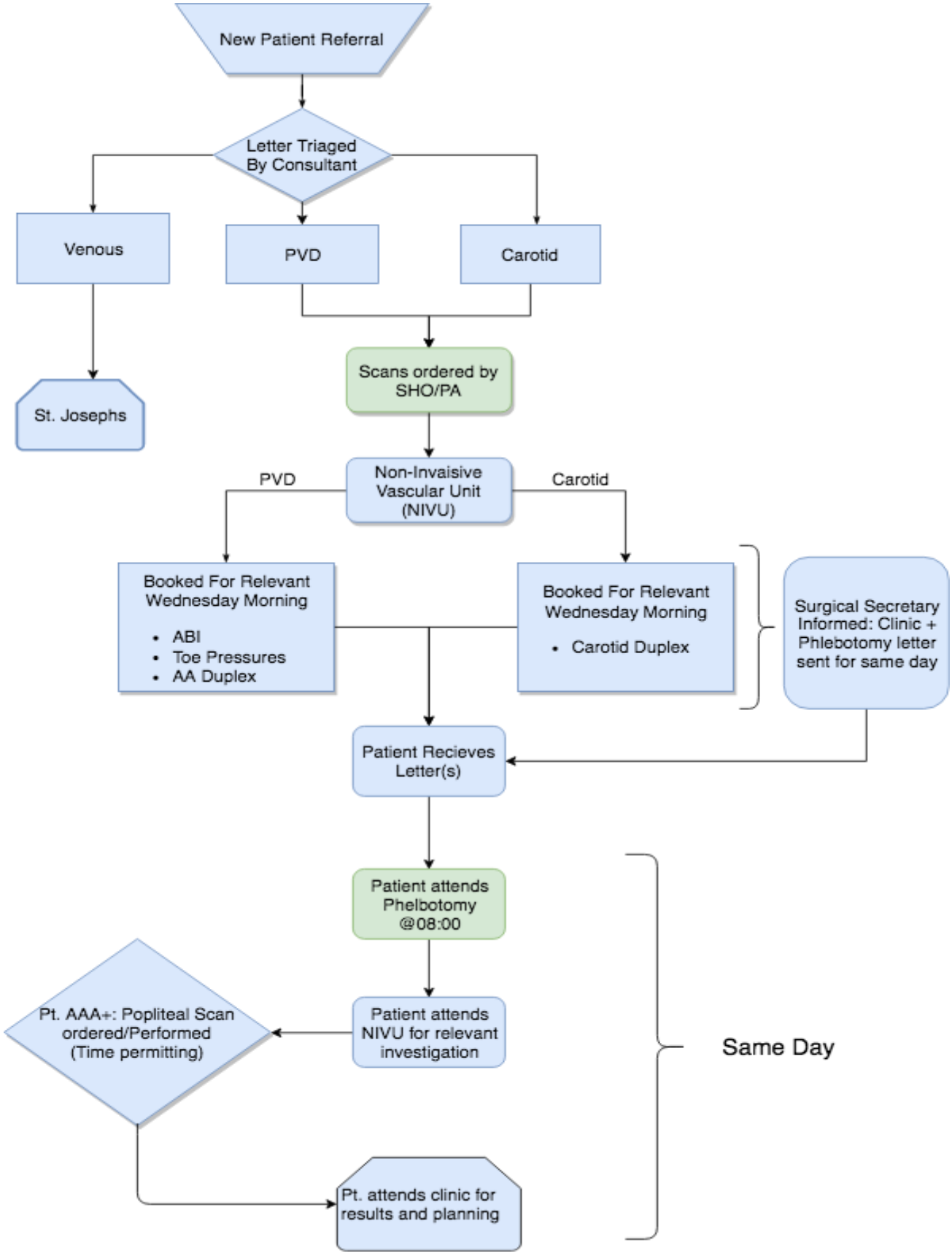


Figure 3. 10 Proposed Process Flow Map: Green boxes denote novel steps

3.4.3.2 Phlebotomy

After discussion with the phlebotomy department about the best way to order bloods for patients who may not be attending for several months it was discovered that a similar protocol was already in place with another team in the hospital. After establishing with the phlebotomy management that the vascular clinic introducing a similar protocol would not negatively impact them or another department it was decided to use a similar protocol. Figure 3.11 shows the design for a sticker to be printed by the hospital. This sticker can be attached to a blood test form (appendix B) with a patient information sticker and sent out along with the patient's clinic appointment letter with instructions to attend phlebotomy, fasting at 08:00am on the day of clinic. It was initially envisaged that sticker may be attached directly to the appointment letter as a lower carbon option but as phlebotomy requires a paper record, attaching it to a blood form as per the already established protocol was agreed upon.

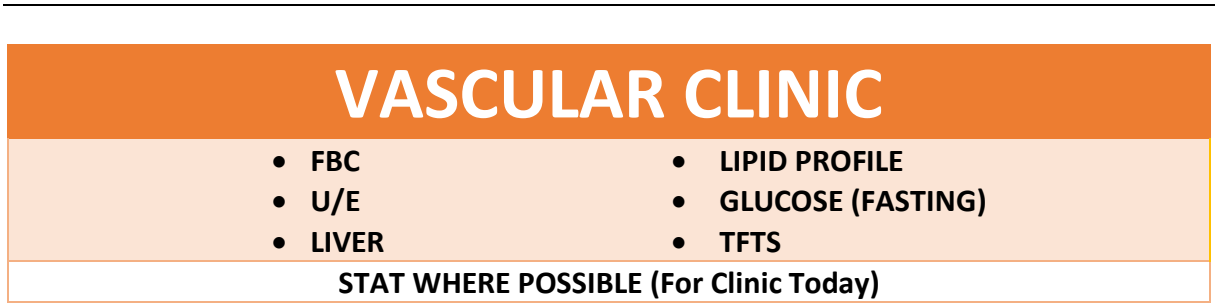


Figure 3. 11 Prototype Vascular Clinic Bloods Sticker

To make the triage process clearer it was decided with the project sponsor that a stamp (fig 3.12) with tick boxes could be used instead of handwriting on the printed referral letter which would then be photocopied and disseminated to SHOs/PAs. This would be used in conjunction with the newly disseminated protocol to regulate the ordering of investigations.

☐ PVD	☐ Veins	☐ AAA	☐ Carotid
☐ URGENT		☐ ROUTINE	

Figure 3. 12. Prototype of Triage Stamp

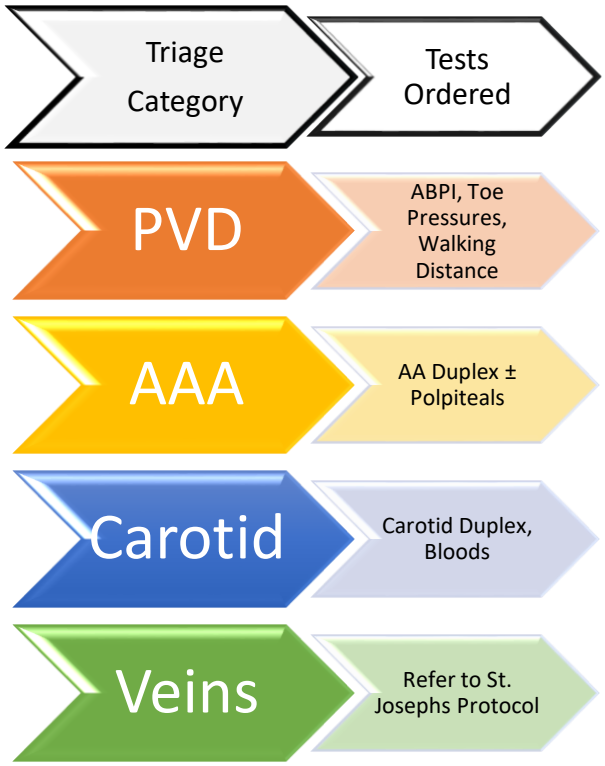


Figure 3. 13 Ordering protocol to be used in conjunction with triage stamp

3.4.4 Control

The control phase is concerned with ensuring the longevity and prosperity of the project and will be discussed in greater detail in the following evaluation chapter.

3.5 Summary

This chapter began with an overview of some of the QI models in use in healthcare today. The tools of the Lean-Six Sigma model were described in greater detail as this was chosen methodology for this QIPP. The DMAIC framework was given a brief overview before the results achieved using stake holder analysis, process flow mapping, and driver diagram generation were presented. The methods by which patient data was collected and analysed was then discussed. To conclude this chapter proposed improvements were presented in section 3.4.3

Chapter 4: Evaluation

4.1 Introduction

This chapter is concerned with how the improvements proposed in chapter three are to be implemented, propagated and maintained, this will be done in line with the control phase of the DMAIC framework. Before we look at that however the QIP plan will be readdressed along with its expected outcomes in light of the data that has been gathered and analysed.

4.2 Overview of QIP Plan and Expected Outcomes

The primary aim of this QIP plan is to reduce the number of hospital attendances by new PAD and Carotid patients to the vascular clinic. A secondary aim which was established during the course of this plan was to improve patient survivability by adding baseline bloods on the day of a patients first clinic attendance. Regarding the first aim, a literature review was conducted which sought out similar projects that had been conducted within a healthcare setting, the QI tools that those projects had used and their rationale for such. As this primary improvement aim was a systems improvement not rigorously dependent on medical knowledge the literature review was developed to fields of manufacturing and industry from where many of these QI tools originated. In concordance with the literature review and keeping in mind the primary aim of the project, a list of SMART objectives was generated, it was deemed that the Lean-Six Sigma model of improvement was the most apt for the successful achievement of this plan and its objectives. The first objective of this QIPP was met utilising Lean-Six Sigma's DMAIC framework providing a clear definition of the problem by meeting with stakeholders in February 2019, identifying their level of power and interest in relation to this QIPP, and together identifying high yield targets for improvement. These

high yield targets were then discussed and the best methods for positive change were selected. The second objective was to quantify the problem so that in the future a repeated quantification could be used to determine the progress of the QIPP. Patient mix in clinic sorted by diagnosis and separately by naivety to clinic were measured along with percentage of new patients attending clinic who have been fully investigated. These were determined to appropriately quantify the problem.

Two primary drivers were determined as seen in chapter three and while recommendations were made concerning potential factors that affect these drivers, the project was ultimately concentrated on the coordination between booking scans and clinical appointments.
It was proposed that by clarifying the triaging of the referrals and having a pre-mandated set of investigations based on that triage decision that variability and therefore opportunity for errors within the process may be reduced. Additionally, by formalising the roles of the team within the process, effective communication would be increased and unnecessary attendances may be reduced.

With regard to the secondary aim of this project, literature concerning the specific risk factors for vascular disease was reviewed. A focus was placed on those risk factors that could be assessed using standard blood testing. In conversation with the project sponsor other blood tests were proposed based on their clinical experience. The relevance of these blood tests to vascular disease was also reviewed and shown to merit inclusion in the selected tests seen in fig. 3.11. Meeting with the phlebotomy department it was decided that this new protocol would benefit from following a structure similar to one already in place between phlebotomy and another team in the hospital. This was added to the improved process flow map as was a new node specifying the ordering of investigations by the senior house officer.

These changes along with the creation of a neater triage method and list of standardised tests based on triage category fulfilled the third objective of this QIPP, to produce an improved process flow map and develop a plan for improvement.

Expected outcomes of this project were initially alluded to in chapter one. Firstly, as there is an outpatient waiting list of 608 people for the vascular clinic it is not expected that the clinic size will be reduced, particularly in the short term. In the short term however, it is expected that the percentage of patients attending clinic without being completely investigated will be reduced. It is also expected that the patient mix in the clinic will change. With fewer repeat attendances the ratio of new to returning patients will increase. In the longer term this would reduce the amount of people waiting greater than three months for an appointment from its current level over of 34%. The combined effect of shorter waiting times and fewer hospital attendance along with more in-depth analysis of risk factors would most likely lead to an increased patient satisfaction and survivability.

4.3 Evaluation

4.3.1 Aim of Control Phase of DMAIC

The control phase is the final step of the DMAIC framework and is concerned with how any improvement made is maintained. In this phase the goal is to create a monitoring plan to measure the ongoing success of the QI and a response plan should there be a dip in performance. These plans are then disseminated to those with ownership over the process to ensure the maintenance of the improvement. It is important that this step empowers and emboldens those within the team to make appropriate modifications and be progressive in their appraisal of the new process essentially allowing them to begin another Lean-Six sigma

cycle. This control step has been shown to be vital to sustained change, as where not properly implemented reversion to the previous established process has occurred.

4.3.2 Monitoring and Review

In order to maintain focus minimal metric monitoring must be implemented. This provides an opportunity for clear data on the performance of the process that is not overly time-intensive. As the primary aim for this project was to reduce low yield attendances by new vascular patients to the hospital, this QIPP recommends two quantitative measurements be recorded. Firstly, a measurement of short-term goal achievement. Tracking the percentage of patients who have had all appropriate scans before their first clinic appointment as seen in fig. 3.9. This would be indicative of how many patients are now been channelled down the improved more efficient pathway. This requires someone with knowledge of B.H.I.S. and McKesson to record. The second, more long-term indication of the success of this improvement recommended by this project would be ongoing measurement of patient mix at the clinic sorted by New/Returning/Dressings as seen in fig 3.6. This requires only B.H.I.S and an increase in new versus return patients would correlate with fewer unnecessary attendance by patients in their initial investigations stage. An alternative method which could be utilised to test the ultimate expected outcome would be to directly question the patients to ascertain their level of satisfaction. This data could be investigated independently or alongside the other measurements to assess how people going through the new process view their experience versus those that don't and how overall experiences change along with adherence to the new protocol.

As previously mentioned there were many drivers of the problem statement laid out in this project, identified by many people within the process. To further improve the process here and drive continued buy-in of the stakeholders in this QIP the improvements here could be applied to those areas generating further success.

4.3.3 Expected Results

It is expected that this QIP will provide an enduring change in the pathway. New vascular patients take in the process of their initial diagnosis. They will have an increased satisfaction and it is hoped an increased quality of life due to the streamlining and addition of laboratory bloods to the process. Once this process is implemented it may be modified to better suit changes in other parts of the system, such as if the NIVU were to add scanning suites. These changes, guided by the DMAIC framework laid out here will provided added quality and reduced waste to the process. Patients will have their hospital attendances reduced from six visits down to ideally one but conservatively two when compared with the old pathway while at minimum receiving the same level of investigation. These investigations will be standardised across all patients within their category. In the long term this increased efficiency will also reduce the waiting list for the vascular clinic or at least time spent on the waiting list for the clinic.

4.4 Dissemination Plan

In order for this plan to be successfully implemented it must be appropriately disseminated. Key stakeholders who have been kept in contact with throughout the QIP should be formally assembled and presented with the recommendations of the project. At this meeting a short

Power Point or poster presentation may be useful in conveying the plan. A hard and digital copy of this plan should be made available to the SHOs as the most routinely changing members of the team. It is important that they are familiar with this process from the beginning of their rotation. Outside of the key stakeholders the presentation of this project at a multi-disciplinary QI session would provide external viewpoints which may aide the project going forward. The Beaumont Lunch & Learn session would be well suited as the attendees would be familiar with institution where the QIP is to be implemented. The wider the dissemination of this plan the greater amount of feedback that would be received, additionally, it would serve to incentivise continuing achievement within the team as their work in quality improvement is appreciated.

4.5 Summary

This chapter provided an overview of the QIPP and it is expected to reduce clinic attendances and improve patient survivability. How the success of this QIP would be evaluated and how said success would be sustained after the project, plus the results of the metrics intended to measure these was also discussed. To conclude this chapter the intended methods for disseminating the plan to all relevant parties was discussed.

Chapter 5: Discussion & Conclusion

5.1 Introduction

This chapter discusses the likely impact of this QIPP on the stakeholders and the organisation. The perceived strengths and limitations of the project and the recommendations this project makes regarding future quality improvement in this area. Finally, the lessons in quality improvement that have been learned by undertaking this QIPP and how they may be applied to any and all future endeavours in QI are explored.

5.2 Project Impact

5.2.1 Stakeholders

The QIPP described here focuses on removing waste from and adding quality to a system by ensuring clear lines of communication between all stakeholders involved. This should have a positive benefit on all of the high power, high interest stakeholders (fig. 3.3). As there are clearly defined operational procedures concerning all patients with suspected peripheral vascular disease (PVD), abdominal aortic aneurysm (AAA), or carotid stenosis, the ordering of investigations and subsequent booking of Clinic and non-invasive vascular unit (NIVU) appointments, the senior house officers (SHOs), Surgical secretaries and NIVU staff are required to carry less uncertainty. This has been shown to increase performance and reduce anxiety.(67) Replacing hand written messages with a more clearly legible stamp will make it easier for the SHOs and secretaries who need that information to order the appropriate tests and book clinic appointments with the right degree of expedience. Formalising that it is the SHO who will be the one who orders the investigations will not increase the workload they currently have as it is currently a part of their role but it does ensure that the role does not revert back to the NIVU should a subsequent rotation not be made aware of this task. Once

familiar with the regularity of the new process, the vascular physiologists too will have certainty in which investigations will need to be performed on which patient. They will feel a greater impact should the recommendations in section 5.5 such as to open the third scanning room to outpatients be enacted.

Regarding stakeholders from lower interest group particularly phlebotomists, the potential for negative impact on their service was discussed and it was decided that as there are no formal appointments to be made and that the number of people to be added to their workload would constitute a small percent of their throughput that any negative impact would be negligible at best.

The low power, high interest group is where the stakeholders who stand to be most impacted by this QIPP, the patients stand. They, as stated throughout, will feel positive impacts in both satisfaction and survivability. Negative impacts from the patients point of view may include a longer time spent in the hospital with an earlier start when they do attend, any anxiety that may exist regarding phlebotomy and the necessity for a fasting blood sample.

5.2.2 Organisation

It was noted without being measured during the data collection phase of this QIPP that the vascular clinic frequently ran over time, negatively impacting the clinic which was due to follow it. In the short term, having all investigations available to the doctors in clinic without them needing to search through McKesson or alternative imaging suites for scans that are not there, and them then having to order investigations and enquire about the possibility of the patient being investigated before the end of clinic may increase the throughput of patients

allowing clinic to finish earlier. A long term potential positive impact would be that by being able to incorporate more new patients each clinic that eventually it may be appropriate to reduce the clinic size, also facilitating an earlier finish time.

NIVU throughput will be reduced from vascular referrals but an increase in output will occur as more scans are performed with fewer appointments. This drop in physical appointments may initially appear as a reduction in productivity depending on which metrics the NIVU use to calculate such figures. However, the same number of patients will be receiving the same scans that they would have received before, but in fewer appointments, due to more efficient, standardised ordering. It is more likely that regardless of metrics used the capacity of the NIVU will be seen to increase.

By adding baseline bloods it is envisaged that there will be better management of risk factors reducing the likelihood of vascular admission for these patients. Saving on average 17 bed days per PAD patient admission (19).

5.3 Strengths of the project

A key strength of this project has been the support and willing investment in change shown throughout the organisation, with willingness to take time out to share knowledge evident across the board. The project sponsor was invested from the beginning and their insight in to likely areas for improvement within the process was essential for the timely completion of a QIPP with dual aims. This was particularly true for the define portion and improve phases of the project.

The action learning group set up amongst peers also conducting QIPPs allowed cross pollination of ideas and another space to present and clarify the process and goals of the QIPP as they developed.

With respect to the strengths of the data, the population size for this project was high given the time constraints of the QIPP and the data collected clearly demonstrated the veracity of the problem statement in numbers and elucidated areas where improvements could be made. The data also provided measurements that could be repeated as review measurements to monitor the success of the process in the future.

5.4 Limitations of the project

The project was limited by the time available in which to complete it, ideally additional data would have been collected over an additional four weeks to achieve an ideal Cochran's number. As both databases were either completely or relatively new to the principal investigator it is possible that greater insight may have been revealed by a more skilled operator. As this plan has not being implemented it was not possible to troubleshoot the process and instead the protocols have been developed purely based on the advice of the experienced members who were consulted. Understanding specifically why patients did not attend was not possible without conducting a survey of the patients. This information could have added more context to who within the new patient group could be targeted initially to provide the highest yield improvement As multiple drivers of the problem were identified and it was not feasible to target all of them in this single project the degree of positive change may be throttled by those negative drivers.

5.5 Recommendations

It is recommended that everyone responsible for the successful implementation of this new process make themselves familiar with the process flow map and that they propagate that knowledge to those that come after them, particularly to SHOs and those covering annual leave.

The recommended solutions to secondary drivers of the problem statement should be further investigated. They were:

1) The NIVU space dedicated to in-patient scanning be repurposed for the three hours that the clinic is running.
2) It becomes part of normal operating procedure in the NIVU that patients with a suspected AAA diagnosis get a popliteal aneurysm investigation in the course of that appointment should an aneurysm be seen.
3) As this new process still requires the use of two non-communicative computer systems all staff should have a passable knowledge of both systems. Ideally it would be recommended that a single system be used for all booking but as that would require high level systemic change it is deemed improbable.

Speaking with the NIVU staff it was deemed feasible to perform AA and bilateral popliteal duplex scanning in the 30 minute appointment window. Currently they run an AA screening clinic where the appointment slots are 15mins. Were these recommendations implemented, the scanning capacity of the NIVU on the morning of clinic would increase from 24 scans in three hours to a maximum of 54 in the same period.

Finally, it is recommended that the process is routinely audited against the plan laid out here with a recollection of data twelve months after initial data collection and that the plan laid out here is frequently amended where appropriate to maximise quality delivered.

5.6 Learning about Quality Improvement

Undertaking this QIPP without prior experience in the field meant there was a steep learning curve. Following the recommended reading and lecture series provided by the college provided a basic understanding of some of the tools and approaches to QI used in healthcare. To be comfortable in executing this QIPP it was necessary to further develop that understanding through independent learning. An appreciation of models such as total quality improvement, Lean, Six Sigma and Lean-Six Sigma were developed along with the tools used by these models such as the Plan, Do, Study, Act (PDSA) cycle, the DMAIC framework, driver diagrams, multi-axis stakeholder analysis, a deeper understanding of process flow maps, fishbone diagrams and the five whys. These are all tools to be utilised while conducting a project in theory no different from learning a statistics package or mass spectrometer. Where the writer found QI diverged from their previous experiences in academic research was the level of involvement throughout the entire process. Both experiences require fastidious planning and meticulous attention to detail if they are to succeed maximally. However the length of the process and the potentially never ending cycle of QI that might be initiated by the QIPP could be seen as daunting if not carefully metered. There was also a required flexibility in conducting this QIPP as targets began to shift during the define phase when it was realised that the focus was too narrow to achieve the goals desired. This flexibility in research was a valuable learning point. On a whole this project felt quite different to the “develop a null hypothesis and disprove approach” previously experienced in research. The

value of managing human factors when there are so many people involved in the success or failure of a process was also a key learning point. QI has shown that it is not enough to provide the best possible care but we should challenge what is possible.

5.7 Summary and Conclusion

Vasculopaths are a complicated and increasing patient cohort who require a relatively high degree of investigation upon initial presentation. Without careful co-ordination of the many people involved in providing care for these people unnecessary hospital attendances can occur. This QIPP aimed to reduce the number of hospital attendances by newly referred vascular patients in the process of their initial investigations. A strategy was developed which would see a reduction in attendances of 66% without a loss in services provided. This included a standardisation of triage, investigation ordering and booking. In this strategy a step which would improve the survivability of this cohort was added without increasing hospital attendances. By adding laboratory bloods it is possible to screen for several of the risk factors for cardiovascular disease and make timely interventions. This proactive management may reduce hospital admissions saving the patient and the hospital 17 bed days per PAD admission. As stated previously a key factor in quality improvement is improving patient satisfaction. Reducing hospital attendances, in-patient stays and increasing survivability are all important metrics in patient satisfaction and in the quality improvement of healthcare. This QIPP aims to achieve the aforementioned goals and has provided recommendations to maintain and develop the process of improvement further.

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Appendices

Appendix A

Finalised Vetting Categories		Inpatient Timeframes	Outpatient Timeframes (BH)
Referral Categories	Clinical characteristics/outcomes of conditions within category	Recommended time to imaging to minimise risk and/or achieve best clinical outcomes	Recommended time to imaging to minimise risk and/or achieve best clinical outcomes
7. Immediate	- Imminent risk of death - Trauma major or minor - Irreversible deterioration if not seen immediately	7	
8. Urgent	- Risk of permanent damage to organ system if imaging delayed - Rapidly progressing dysfunction (over a period of days or weeks) in established conditions -Assessment of clinically suspected malignancy and known malignancy in patients who will be potential candidates for radical or systemic treatment, or staging of known high-grade malignancy prior to definitive treatment	8	
9. Semi Urgent	- Risk of damage to organ system if treatment is delayed beyond - Assessment of patients with clinically suspected malignancies who are unlikely to be candidates for radical or systemic treatment.	9	
10 Non urgent	-Minimal risk of damage to organ system if imaging is delayed beyond 13 weeks -Reassessment of stable/chronic conditions that meet the criteria for review - Assessment of conditions felt to be benign		
11. Specified Date – 3 Mths 12. Specified Date – 6 Mths 13. Specified Date – 9 Mths 14. Specified Date – 12 Mths 15. Specified Date – 18 Mths 16. Specified Date – 24 Mths 17. Specified Date – 36 Mths 18. Specified Date – 36+ Mths	The date of imaging in the request, imaging at specific time in active therapy as part of approved surveillance protocols. This will most commonly apply to follow-up of cancer patients and patients with pulmonary nodules. It will also apply to patients with Radiologically indeterminate pathology where the Radiologist has recommended follow-up imaging for further assessment in the report of the initial investigation.		

Appendix A: Non-invasive vascular unit triage categories

Appendix B

BEAUMONT HOSPITAL CLINICAL
DIRECTORATE OF LABORATORY MEDICINE

Outpatient Request Form

Affix Patient Label Here
Forms without labels will be sent back.
Ensure current outpatient episode number is used

Date Ordered: D D / M M / Y Y Y Y Bleep/Phone No: _____ **(Mandatory)**

Doctor's Signature: _____

Clinical Details: _____

Status: STAT (For clinic today) ☐ Routine ☐

Haematology	Chemistry	Endocrinology	Microbiology	Immunology
Full Blood Count ☐	U/E Profile ☐	Prolactin ☐	Urine Culture ☐	Connective Tissue Disease Screen ☐
Coag Screen ☐	Liver Profile ☐	TFTs ☐	Swab Culture ☐	C3 C4 ☐
INR ☐	CRP ☐	HbA1c ☐	Faeces Culture ☐	Coeliac Disease Screen ☐
	Ca/Albumin ☐	Cortisol ☐	Routine Respiratory Culture ☐	Liver Abs (HEP2ANF, SMA, MITO) ☐
	Ca/Phos/Mg/Alb ☐	FSH ☐	Cystic Fibrosis Respiratory Culture ☐	Inflammatory Arthritis Abs (CTD, RF, CCP) ☐
	Bone Profile ☐	LH ☐		Specific IgEs
	Lipid Profile ☐	E2 ☐		**Must specify allergen**
	Glucose (F) ☐	PTH ☐		_____
	Random ☐	B12 ☐		
	Urine Albumin ☐	Folate ☐		
	Ur Protein/ Creattinine ☐	Ferritin ☐		
	Iron & TSAT ☐	Vitamin D ☐		
		Testosterone ☐		

Other Tests:

Please bring this form to the "Blood Test" area. If you are not having blood taken today, keep this form in a safe place until your return. If you are not fasting, attending 'Blood Tests' in the afternoon is faster' LF-GEN-0008 Revision 4 Date of Issue 7th April 2015 MR124D

Appendix B: Outpatient phlebotomy request form