Anticoagulation for atrial fibrillation in general practice: a critical evaluation of the implementation of changes to practice.

By

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Declaration.

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Abstract.

This thesis critically evaluated, and updated existing knowledge, improving scholarship about the nature of oral-anticoagulation (OAC) use and changes to OAC management in general-practice in patients with atrial fibrillation (AF).

This thesis represents an original contribution to knowledge by presenting a new integrated-care model for AF/OAC care in general-practice; Developed uniquely via an Insider-Researcher lens and assessment of AF/OAC care; Which used context-specific data to combine existing methods within related methodologies in a novel way; To provide an original exploration of the embedding processes involved in AF/OAC care in general-practice.

This thesis also provides a significant contribution to knowledge in several ways. Firstly, this thesis challenges the previously accepted assumptions about OAC use and underuse in general-practice, establishes and answers a knowledge-gap about the extent of GP involvement in the OAC rates reported. Secondly, this thesis proposes a new, initial theory, of how a general-practice affected the OAC rates reported; whilst, also identifying a further literary gap about the essential roles for General-Practice Nurses (GPNs) required to deliver improved AF/OAC care, via a general-practice integrative-care model. Thirdly, the insider-researcher approach that was taken using a form of realist evaluation incorporating the Normalization Process Theory (NPT), positively impacts on existing nurse-led research within general-practice settings.

The context of this study is the high stroke burden attributable to the increasingly prevalent cardiac arrythmia AF, for which an effective risk-reducing treatment, OAC, is historically underused and for which general-practice holds responsibility. This study involves a mixed-methods approach, which includes a quantitative examination of the clinical pathways and management of an AF cohort, and a qualitative investigation about clinicians' experiences of transformation of OAC practice in a large general-practice in Northern England.

Using realism as a methodological perspective, an insider-researcher approach incorporating the Normalization Process Theory (NPT) produced a new program theory about the roles of general practitioners and other practice staff in stroke prevention work in AF patients.

Between June and October 2013, the electronic records of 297 AF patients included in a general-practice caseload were analyzed, following their initial presentation to eventual diagnosis and treatment with OAC. Then, between October and December 2013, clinical staff within the same setting were also questioned about their roles before, during and after changes to OAC and AF care in the general practice.

Findings showed that historic underuse did exist as suggested by the literature with only 51.9% of patients initially taking OAC in 2013. Furthermore, the findings also indicated the presence of a limited GP role, who were involved in only 24.9% of all previous AF diagnoses. However, several contextual factors, which resulted in a series of mechanisms for OAC service change, also existed. These led to increased general-practice diagnoses of AF, totaling 78.6% of new AF patients and a 91.1% uptake of OAC in all patients diagnosed with AF after 2013 up to 2017.

Historical OAC use in treating AF patients in general practice has been previously shaped by the GPs' willingness to refer to specialists and by the outcomes of decision-making by specialists. Furthermore, there has been no previous recognized role for nurses in AF/OAC care, both within the literature, and within this practice. This was exemplified by a lack of awareness about stroke, AF and OAC; which also resulted in significant clinical anxiety.

AF and OAC care are complex interventions that require multiple Context-Mechanism-Outcome (CMO) factors, occurring in various configurations, to achieve changes in clinical general-practice. Nursing activity in general practice was integral to achieving improvements in OAC treatment change and improved outcomes. The nature of roles, knowledge and agency are critically integrated to processes of OAC and AF treatment change and are, themselves, constructs of power that reflect embedded historical general-practice funding models. Outcomes of significantly increased OAC use, routine AF case-finding and internal OAC initiation occurred because of role-specific CMO-configurations.

Increases in OAC use to prevent stroke is possible in general-practice using an integrated-care approach. But further research is required to explore the possible variations of integrated care that are used more widely in general-practice, and explore patients' roles within decisions about OAC use, within these integrated-care models.

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For Michael, the true academic.

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Abbreviations and Glossary of terms.

Abbreviation	Term	Definition
AF	Atrial fibrillation.	An atrial arrhythmia characterised by an absence of regular P waves on an electrocardiogram, and normally resulting in a fast-ventricular response.
ADR	Adverse Drug Reaction.	An adverse event or side-effect that occurs because of a therapeutic intervention.
ANP	Advanced Nurse Practitioner.	A registered nurse employed in primary and secondary-care-based settings that has completed a clinical master's degree qualification.
	Anticoagulation.	A form of thromboprophylaxis involving the use of anticoagulant drugs such as warfarin that inhibit the coagulation/clotting of blood.
APL	Antiplatelet therapy.	A form of thromboprophylaxis involving the use of antiplatelet drugs (such as aspirin) that inhibit the formation of blood clots.
	Antithrombotic therapy. (See 'thromboprophylaxis').	Includes both Antiplatelet and OAC therapies.
	Antiplatelet therapy.	e.g. aspirin. Therapies that that inhibit the formation of blood clots via their action on platelets.
	Arrhythmia.	An irregularity in the coordinated rhythm of the heart.
CAF	Chronic AF.	AF, formerly known as Permanent AF, which cannot be corrected. Medications and controlled electrical shock cannot return the heart to normal rhythm.
	Cardioembolic stroke.	A clot originating in the heart that breaks free travelling in the blood (an embolus) only to block an artery in the head causing a stroke.

CCG	Clinical Commissioning Group.	The modernized local governing body of primary health services that superseded Primary care Trusts.
CDSS	Computer Decision Support Software.	A computer program that automatically calculates clinical decisions.
CHA_2DS_2VASC	Stroke-risk score.	An acronym of an updated stroke-risk point-scoring system based upon patient characteristics of stroke-risk factors including: Congestive heart failure or left ventricular dysfunction 1, Hypertension 1, Age ≥75 years 2, Diabetes mellitus 1, Stroke or transient ischaemic attack or systemic thromboembolism 2, Vascular disease* 1, Age 65-74 years 1, Female sex (sex category) 1, *Vascular disease defined as previous myocardial infarction, peripheral arterial disease, or aortic plaque.
$CHADS_2$	Stroke-risk score.	An acronym of a stroke-risk point-scoring system based upon patient characteristics of stroke-risk factors including: Congestive heart failure or left ventricular dysfunction 1, Hypertension 1, Age ≥75 years 1, Diabetes mellitus 1, Stroke or transient ischaemic attack or systemic thromboembolism 2.
CIS	Contraindications.	Any factor deemed to be an absolute or relative reason to withhold OAC.
C-M-Os	Context-Mechanism-Outcomes	Aspects of a given reality that possess potential emergent properties, and when combined, form configurations to enable realist-evaluation explaining, what works for whom, when and under what circumstances.
DN	District Nurse.	A registered nurse usually employed by a PCT, that has specific skills, knowledge and a post-registration qualification about caring for patients in their own homes.

DOAC	Direct Acting Oral Anticoagulants.	Previously referred to as NOACs.
ECG	Electro-Cardio Graph(y).	A device which traces the electrical activity of the heart by recording the electrical potentials at electrodes placed at various locations around the chest. The recording produced by the electrocardiograph is referred to as an ECG.
	Embolic.	See cardio-embolic.
GP	General Practitioner.	Lead, medically qualified, primary care practitioner (UK).
HASBLED	Bleeding-risk score.	An acronym of a bleeding-risk point-scoring system based upon patient characteristics of bleeding-risk factors including: Hypertension 1, Abnormal renal and liver function (1 point each) 1 or 2, Stroke 1, Bleeding 1, Labile international normalised ratios 1, Elderly (age >65 years) 1, Drugs or alcohol (1 point each) 1 or 2. Maximum score 9.
HCA	Health Care Assistant.	An unregistered, skills-based clinical practitioner.
INR	International Normalised Ratio.	A globally standardised test of clotting times measuring prothrombin using the tissue factor/phospholipid combination called thromboplastin.
LES	Locally Enhanced Service.	Schemes that are agreed locally between PCTs and their primary care contractors to meet identified needs and priorities. These could either adopt national specifications or be locally agreed.
MDT	Multidisciplinary Team.	Different professional roles that work together forming one team.
NC	Nurse Clinician.	A registered nurse usually employed by a GP, that has completed a clinical master's degree qualification.
NICE	National Institute for Health and Clinical Excellence.	NICE is the independent organisation responsible for providing national guidance on the promotion of good

		health and the prevention and treatment of ill health.
NMP	Non-Medical Prescriber.	Nurses, Midwives, Pharmacists and other allied healthcare professionals (AHPs) who have completed an accredited prescribing course and registered their qualification with their regulatory body, are able to prescribe. In the context of this thesis NMPs are Independent prescribers are nurses who have successfully completed an NMC Independent Nurse Prescribing Course (also known as a v200 or v300 course) and are registered with the NMC as an IP.
NOAC	Novel Oral Anticoagulants.	Newer OAC drugs that directly affect clotting factors but do not affect the vitamin K-dependent clotting factors now known as DOAC. Includes: Apixaban, Dabigatran, Edoxaban, and Rivaroxaban.
NPT	Normalization Process Theory.	A theory relating to the embedding of complex interventions.
NVAF	Non-Valvular Atrial Fibrillation.	Patients with AF and no Valvular AF.
OAC	Oral Anticoagulation.	Therapy that inhibits the coagulation/clotting of blood via their actions on various clotting factors. e.g. warfarin/Apixaban.
p = <0.05	Significance (statistical).	A result is deemed statistically significant if the probability of the result occurring by chance is less than 1 in 20, if there no difference, effect or association.
PAF	Paroxysmal AF.	AF that occurs sometimes and then stops which may last for seconds, minutes, hours, or days before the heart returns to its normal rhythm.
	Palpitations.	The experience of one's own heartbeat as an awareness of the heart beating or a thumping sensation originating in the chest. This may or may not be associated with an arrhythmia.

PBC	Practice Based Commissioning.	A government policy, introduced in 2005, designed to give general practitioners, nurses and other primary care professionals the power to decide how NHS money is spent in their local area.
PCT	Primary Care Trust.	The local governing body of primary health services.
	Persistent AF.	AF that does not stop by itself but is potentially reversible. Medications or a special type of electrical shock (called cardioversion) is used to help the heart return to normal rhythm. If no treatment is given, the heart will stay out of rhythm.
PN	Practice-Nurse.	A registered nurse usually employed by a GP, that has specific skills and knowledge about general practice.
POCT	Point-Of-Care Test.	A mobile testing device that enables INR-testing to be undertaken with the patient present.
	Primary care.	Healthcare delivered outside hospitals. It includes a range of services provided by GPs, nurses, health visitors, midwives and other healthcare professionals and allied health professionals such as dentists, pharmacists and opticians.
QOF	Quality and Outcomes Framework.	The General Medical Council's GP-contract and clinical framework that arranges payment for practice.
Read code	Read codes are a coded thesaurus of clinical terms.	They have been used in the NHS since 1985. There are two versions: version 2 (v2) and version 3 (CTV3 or v3). Both versions provide a standard vocabulary for clinicians to record patient findings and procedures, in health and social care IT systems across primary and secondary care.
	Sinus Rhythm.	The normal pattern of electrical activity (and subsequent muscular contraction) of the heart.

SOP	Standard Operating Procedure.	A formalised step-by-step guide of specific systems for staff.
	Thromboembolism.	The embolization (dislodging and transportation in the blood) of a thrombus.
	Thromboprophylaxis.	The administration of antithrombotic therapy (anticoagulation, antiplatelet therapy) for the prevention of thrombus formation.
	Thrombus.	Blood clot.
TTIR	Time-In-Therapeutic-Range.	TTIR is a means of assessing the quality of anticoagulant control defined as the proportion of time an individual patient's INR values are within the target range. It is expressed as a percentage and assumes a linear change between INR results.
VAF	Valvular Atrial Fibrillation.	Patients with AF also with moderate to severe mitral stenosis or prosthetic heart valves and valve repair.
VKA	Vitamin K Antagonist drugs.	e.g. Warfarin. Drugs that block the action of vitamin K-dependent clotting factors to prevent thrombus formation.

Chapter 1.

Background.

This thesis will explore the challenges that general-practices face when managing Oral Anticoagulation Therapy (OAC) for reducing the risk of stroke for patients with atrial fibrillation (AF) from the lens of an insider or, clinician-researcher. The insider-researcher approach encompasses the researcher also working as a Nurse Clinician (NC) within general practice and will enable the complexities associated with OAC use and implementing changes to OAC practice in this setting to be explored. Underuse of OAC is a generally recognized problem and concern within AF-populations. Therefore, this thesis will also identify factors that impact positively or negatively on OAC therapy in patients with AF and will use these factors to formulate a model for advancing the use of OAC in general practice.

1.1 Stroke and AF.

Stroke is a major cause of death and disability worldwide, with a globally estimated 80.1 million prevalent cases in 2016 strokes annually, resulting in 5.5 million deaths and another 116·4 million disability-affected life years of people suffering permanent disability (GBD 2016 Stroke Collaborators 2019).

Within the United Kingdom (UK), the most recent data suggests that there are over 100,000 strokes annually which resulted in nearly 38,000 deaths and over 1.2 million stroke survivors (Stroke Association 2018). Furthermore, there is a significant existing societal cost burden which is expected to increase over the next two decades, due to an increasingly ageing population (Patel *et al*. 2017). Therefore, stroke is now a key clinical priority for UK health services and forms part of the long-tern NHS plan (NHS 2019).

Strokes are the result of brain tissue death with associated loss of function and are caused by either cerebral bleeding (haemorrhagic strokes) or reduced blood flow within cerebral arteries (ischaemic strokes). The latter ischaemic stroke types result from the presence of emboli or thrombosis (Sacco *et al.* 2013) and it is ischaemic strokes which will be the focus of this thesis. Ischaemic strokes have several underlying causative, non-modifiable risk-factors and modifiable risk-factors, such as Atrial Fibrillation (AF) (Wolf 1985). In the UK, it is estimated that 1 in 5 of over 100000 strokes are caused by AF (National Institute for health and Care Excellence (NICE) 2019).

AF is the most common cardiac dysrhythmia, cited as being a major cause for disability and death (Wolf *et al.* 1991; Wang *et al.* 2003). Between 2000 to 2010, the UK estimated prevalence in adults was between, 2.14% increasing to 3.19% (Adderley, *et al* 2018) and new cases may number between 14-17 million in Europe by 2030 (Zoni-Berisso *et al*. 2014).

The National Collaborating Centre for Chronic Conditions (2006) describes AF as,

"….*an atrial tachyarrhythmia characterised by predominantly uncoordinated atrial activation with consequent deterioration of atrial mechanical function*."

It is characterised by an irregular pulse rhythm which may be symptomless, but which may cause symptoms of palpations, rapid heart rate, shortness of breath and syncope.

AF was first recognised as an independent risk factor for stroke in the 1978 landmark Framingham study (Wolf *et al.* 1987), where it was determined that compared to controls of patients matched without valvular heart disease, by blood pressure measurement and age, patients with AF were 5-6 times more likely to suffer a stroke (Wolf *et al,* 1991). This translates to one in six of all strokes being caused directly by AF (Fuster *et al.* 2006). Further studies that have examined strokes types, undetermined by usual diagnostic investigations and termed cryptogenic, have also identified undiagnosed AF after longer periods of cardiac monitoring, at rates of between 12.4 at 3 months (Sanna *et al.* 2014) and 16.1% at 12 months (Gladstone *et al.* 2014). AF is therefore an important and common factor in stroke aetiology.

The cardio-emboli that are produced during AF, is nearly twice as likely to cause a fatality, whilst also doubling the negative resulting functional disability, than for strokes from non-AF causes (Wolf *et al.* 1987; Lin *et al.* 1996). There is also a greater than 20% reduced survivability of strokes caused through AF beyond the initial stroke, at 90, 180 and 360 days (Stead *et al.* 2011). Furthermore, the AF stroke reoccurrence rates are also nearly 3 times higher than strokes caused by non-AF (Lin *et al.* 1996).

A number of important pathological processes are believed to contribute to the development and maintenance of AF including extracellular matrix alterations as found in Interstitial and replacement fibrosis, inflammatory changes, amyloid deposits (The Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC) 2010). Further factors such as myocyte alterations, have been found in apoptosis, Necrosis,

Hypertrophy, Dedifferentiation, Gap junction redistribution, Intracellular substrate accumulation (hemochromatosis, glycogen). Other factors that contribute to the development of AF are micro-vascular changes and endocardial remodelling (endomyocardial fibrosis). The process of remodelling of the cardiac atria results in changes in the electrophysiology and so the ability to maintain a normal sinus rhythm. Several inflammatory processes are understood to be responsible for this, which also results in changes to coagulability within the atria (Lip 1997). In patients with AF, it has been shown that atrial appendages are much larger as a result of atrial re-modelling and reduced pumping efficiency. This results in a delayed fill and emptying of this space (Thambidorai *et al.* 2005) which increases areas of the enlarged atrial appendages (Mügge *et al.* 1994) allowing blood stasis. Furthermore, elevated levels of pro-coagulant proteins (Ederhy *et al.* 2007) result in a pro-thrombotic state (Lip 1997), thus placing patients with non-rheumatic AF (NVAF) at risk of large vessel thrombus and arterial emboli and stroke (Lip and Lowe 1996; The Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology 2010).

In 2001, four main classifications of AF were described namely, acute causes, AF without associated cardiovascular disease in younger patients, AF with associated cardiovascular disease, and neurogenic AF (Fuster *et al.* 2001). However, the most recent European AF guidelines (Kirchhof *et al* 2016) have indicted the presence of seven types of AF which have specific causes and underlying mechanisms (Table 1). Furthermore, describing four different patterns that AF patients may present in practice (Table 2).

Some forms of AF confer a greater risk of stroke than others. For example, AF patients who also have disease and dysfunction affecting heart valves – valvular AF (VAF) - are deemed to be at greatest risk of stroke, whereas, patients with AF and normal heart valvular function – non-valvular (NVAF) - are at a lower risk. However, other stroke-risk factors such as hypertension, diabetes, and smoking may also increase risk. The distinction between NVAF and VAF within this thesis is important because of the previous evidence that relates to preventing strokes in these groups of patients. For example, previously, the stroke risk of NVAF and VAF patients in some guidance has been treated differently. However, the risk of stroke associated with all forms of AF can be reduced with anticoagulant drugs such as warfarin, and sometimes with surgery and lifestyle modifications (Wolf *et al.* 1987; Boysen

et al. 1988). However, currently, the distinction between VAF and NVAF is no longer recommended for the assessment of stroke prevention (January *et al*, 2019), but different definitions of VAF and NVAF have been applied previously to various clinical trials of warfarin and other medicines aimed at reducing the risk of stroke; often only including those patients considered to have NVAF, which limits treatment choices (De Caterina & Camm 2014).

Table 1. AF type, clinical presentation, possible pathophysiology (Kirchhof *et al* 2016).

AF type	Clinical presentation	Possible pathophysiology
AF secondary to structural heart disease	AF in patients with LV systolic or diastolic dysfunction, long-standing hypertension with LVH, and/or other structural heart disease. The onset of AF in these patients is a common cause of hospitalization and a predictor of poor outcome.	Increased atrial pressure and atrial structural remodelling, together with activation of the sympathetic and renin-angiotensin system.
Focal AF	Patients with repetitive atrial runs and frequent, short episodes of paroxysmal atrial fibrillation. Often highly symptomatic, younger patients with distinguishable atrial waves (coarse AF), atrial ectopy, and/or atrial tachycardia deteriorating in AF.	Localized triggers, in most cases originating from the pulmonary veins, initiate AF. AF due to one or a few re-entrant drivers is also considered to be part of this type of AF.
Polygenic AF	AF in carriers of common gene variants that have been associated with early onset AF.	Currently under study. The presence of selected gene variants may also influence treatment outcomes.
Post-operative AF	New onset of AF (usually self-terminating) after major (typically cardiac) surgery in patients who were in sinus rhythm before surgery and had no prior history of AF.	Acute factors: inflammation, atrial oxidative stress, high sympathetic tone, electrolyte changes, and volume overload, possibly interacting with a pre-existing substrate.
AF in patients with mitral stenosis or prosthetic heart valves	AF in patients with mitral stenosis, after mitral valve surgery and in some cases other valvular disease.	Left atrial pressure (stenosis) and volume (regurgitation) load are the main drivers of atrial enlargement and structural atrial remodelling in these patients.
AF in athletes	Usually paroxysmal, related to duration and intensity of training.	Increased vagal tone and atrial volume.
Monogenic AF	AF in patients with inherited cardiomyopathies, including channelopathies.	The arrhythmogenic mechanisms responsible for sudden death are likely to contribute to the occurrence of AF in these patients.

Table 2. Patterns of AF (Kirchhof *et al* 2016).

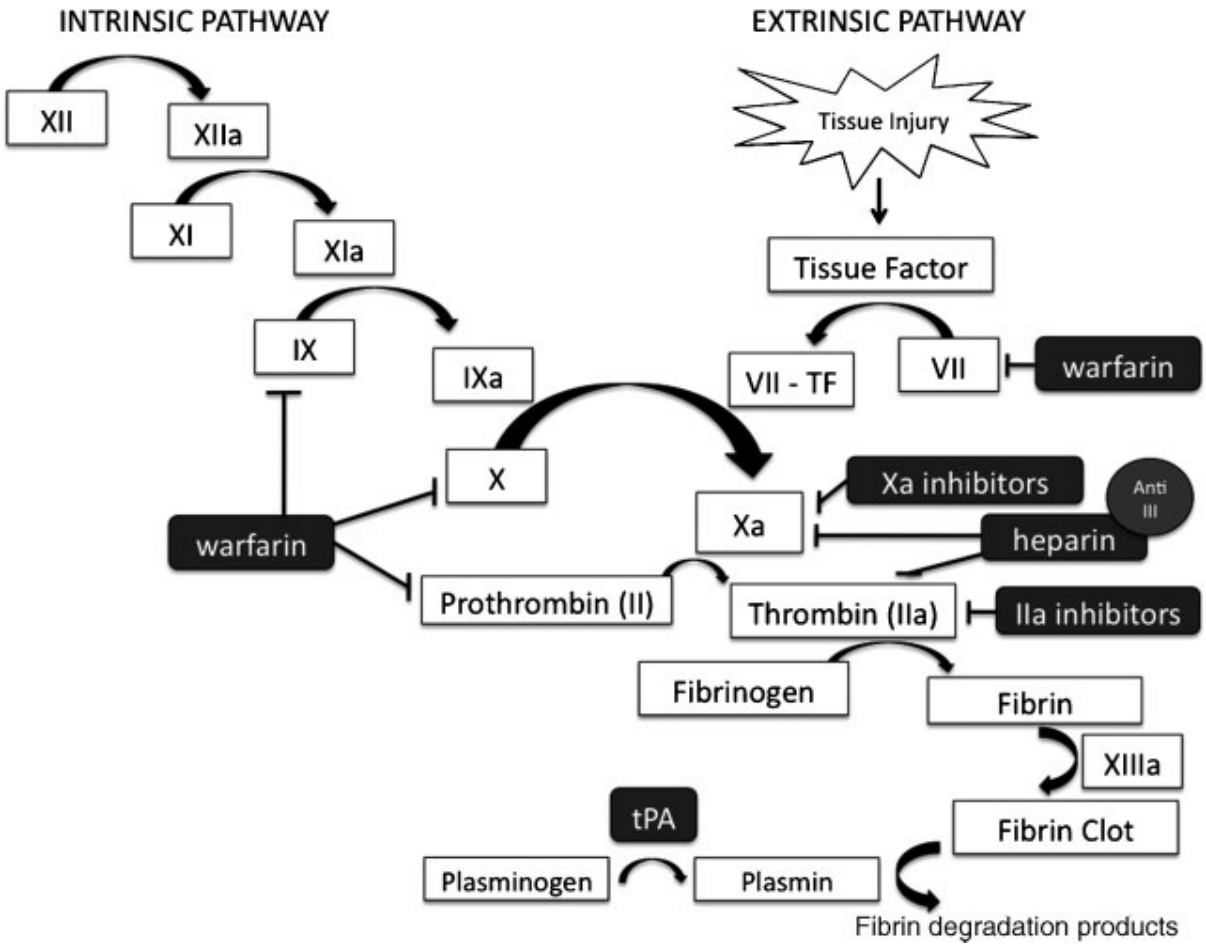
AF pattern	Definition
First diagnosed AF	AF that has not been diagnosed before, irrespective of the duration of the arrhythmia or the presence and severity of AF-related symptoms.
Paroxysmal AF	Self-terminating, in most cases within 48 hours. Some AF paroxysms may continue for up to 7 days. AF episodes that are cardioverted within 7 days should be considered paroxysmal.
Persistent AF	AF that lasts longer than 7 days, including episodes that are terminated by cardioversion, either with drugs or by direct current cardioversion, after 7 days or more. Long-standing persistent AF Continuous AF lasting for ≥1 year when it is decided to adopt a rhythm control strategy.
Permanent AF	AF that is accepted by the patient (and physician). Hence, rhythm control interventions are, by definition, not pursued in patients with permanent persistent AF. Should a rhythm control strategy be adopted, the arrhythmia would be re-classified as 'long-standing AF'.

1.2 OAC for stroke prevention.

This thesis will further only explore NVAF, as a modifiable stroke-risk factor, in which the effective use of oral OAC can mitigate the relative stroke-risk by some 68% (Hart *et al.* 1999). Understanding the biochemical mechanisms and actions on people taking OAC is vital for decision-makers using OAC therapy and is described next.

OACs act upon the haemostasis pathways to prolong clotting times, thus preventing thrombus or clot formation (Hobbs *et al.* 1999). Simultaneously, this action also increases the risk of bleeding (Pisters *et al.* 2010). The haemostatic pathways as depicted in figure 1 (Lazzaro *et al*. 2010), consist of several clotting factors whose actions can be blocked by the specific binding of anticoagulant medications.

Figure 1. Haemostasis pathways and anticoagulant medications.



Two main classes of OACs exist, namely Vitamin K Antagonists (VKAs), the most common of which is warfarin, and Direct Acting Anticoagulants (DOACs). Warfarin was the first OAC developed and was the preferred drug for preventing strokes (Peterson *et al*. 1989) until as recently as 2012. Warfarin acts to block the vitamin K-dependent clotting factors via a reductase protein produced by the liver (Fitzmaurice & Murray 2009). Dabigatran, the first of the DOAC drug class to be licensed by the European Medicines agency in 2009 and approved for NHS use by the UK National Institute for Health and Care Excellence (NICE) (NICE 2012), acts by directly binding to the clotting factor IIa (thrombin). Dabigatran was followed by Rivaroxaban (NICE 2012), Apixaban (NICE 2013) and Edoxaban (NICE 2015) all bind directly to clotting factor Xa, irrespective of their mechanisms of actions. All OACs result in similar outcomes of reducing the relative risk of stroke in patients with NVAF (Hart *et al.* 1999; Connolly *et al.* 2009; Granger *et al.* 2011; Patel *et al.* 2011; Giugliano *et al.*

2013). Although the modes of action within the haemostasis pathway differ between DOACs and VKAs, the DOACs have more predictable dosing between and within patients than their predecessor, warfarin, which was an important factor underlying the rationale for their development. Both classes of OACs also carry a risk of bleeding. However, some DOAC drugs increase the risk of serious gastrointestinal bleeding but have a lower risk of intracranial bleeding compared to warfarin (López-López *et al*. 2017). It is balancing dose stability and bleeding-risk which has conventionally been problematic for clinicians treating patients with warfarin. Dosing of warfarin is relatively unpredictable both between and within patients (Wadelius *et al.* 2004), due to variations in patient genetic subtypes (Johnson *et al*. 2011; Li *et al*. 2017) and multiple food and drug interactions (Wells *et al*. 1994). The effectiveness of warfarin is also achieved within a narrow therapeutic range whereby too low a dose does not reduce the embolic risk, but too high a dose produces an increased risk of serious bleeding (Fitzmaurice & Murray 2009). The greatest concern in relation to this inter-patient and intra-patient variability of warfarin dose-response and stability is therefore the increased risk of bleeding, particularly with use in older people (Europace 2011). This results in the need for regular dose adjustment and monitoring of the International Normalised Ratio (INR)/blood clotting time (World Health Organization Expert Committee on Biological Standardization 1999). As such, warfarin management has been regarded as a complex undertaking, which has been reflected commonly in observations of underuse of OAC in eligible AF patients (Ogilvie *et al.* 2000).

Clinician concerns about patient suitability, often citing assumptions about the heightened risk of bleeding, have resulted in underuse of warfarin in eligible AF patients (Pugh *et al.* 2011). The complexity associated with OAC use stems from the difficulties surrounding selecting the correct patients who may benefit from treatment (Palareti *et al.* 1996). Furthermore, with warfarin, considering the effect and the need for individualised treatment regimens (Johnson *et al.* 2011). The driving clinical need to increase rates of OAC uptake via more predictable dosing has led to the development of the DOAC drugs. Since DOAC introduction in 2012, there has been some improvement in OAC uptake levels. However, underusage of OAC continues to be reported at rates of 29.7% (Henrard *et al*. 2017) and 45% (Fohtung *et al*. 2017). This is more evident in older AF patients and has been

linked to poor adherence to guidelines (Alamneh *et al.* 2016) with limitations in OAC use linked to the role of general practice in OAC management (Dihn *et al.* 2006).

The difficulties associated with the complexity of warfarin management have meant that traditionally, decision-making, monitoring and adjustment of warfarin-dosing, were usually done in specialised, consultant-led clinics based in secondary care settings (Hobbs *et al.* 1999). This also resulted in restricted roles for nurses based around task-based procedures, where the current effectiveness of roles for Advanced Nurse Practitioners (ANPs) are yet to be established (Smigorowsky 2019).

However, the introduction of DOACs has presented the option of more predictable dosing and less frequent monitoring, with a net benefit which emphasizes clinical and cost-effectiveness (López-López *et al*. 2017) and "*societal costs*" (Leminen *et al* 2019) compared with warfarin. This now enables the possibility of transferring management of OAC from secondary care systems into primary care and patient self-management which has been investigated globally in the GARFIELD-AF registry (Kakkar *et al*. 2013) and within the UK by the GLORIA-AF registry (Apenteng *et al*. 2018) .

Health service providers have recently been encouraged to change the models of OAC care provision, from being traditionally been based in secondary care (National Health Service 2009). This is partly in response to the proportion of adults who are now living longer, resulting in predictions of increases in the prevalence of AF (Go *et al.* 2001). The subsequent stroke-risk will therefore add extra burden to existing management systems (Bonomi *et al.* 2001). In the UK for example, the overall age-adjusted incidence of AF per 1000-person years rose from 1.11 in 1998–2001 to 1.33 in 2007–2010 (Lane *et al.* 2017). Similarly, in the USA, the age and sex-adjusted prevalence rates increased over time from 2.7% in 2004 to 4.1% in 2016 (Williams *et al*. 2017). As such, more cost-effective (Bonomi *et al.* 2001; Price 2001) and accessible (Edgeworth & Coles 2010) models of providing OAC care are required. Modern models of OAC in the United Kingdom (UK) have thus expanded to include primary care practice (National Institute of Clinical Excellence 2007).

1.3 Key guideline changes to AF and OAC care.

A scoping search for this thesis found several clinical guidelines to aid patient selection for OAC treatment and organizational changes that have changed the way (we) clinicians, have

implemented clinical practice around OAC use in AF patients. These changes are summarized in Appendix 1 (P.329) but the main points to these key practice changes are listed below in Figure 2.

Figure 2. A summary of evolving key practice changes within the literature.

1991-1994: Trial-based inclusions and exclusions used guiding practice, either OAC or APL.
1998-2001: Notion of risk-factors for stroke to guide treatment. Warfarin preferred over aspirin.
2001-2010: $CHADS_2$ risk-scoring introduced. Warfarin to be used as first line in high-risk. QOF introduced % payments of antithrombotic therapy (APL/OAC) for all AF.
2010-2011: CHA_2DS_2VASC and HASBLED-scoring introduced. No APL in low-risk.
2011-2012: NOAC drugs now preferred as first-line OAC. APL use abandoned.
2013-2015: QOF introduces payment for OAC use in high-risk using $CHADS_2$ risk-scoring. Intermediate-risk still paid by either APL or OAC use.
2015-2018: QOF introduces payment for OAC use using CHA_2DS_2VASC risk-score = > 2.

Earlier, patient selection for general OAC use was guided by results from drug trials and by individual clinical expertise and preference. However, there were concerns about the generalizability of such results collected from highly selected populations who were managed by experts in controlled settings (Sudlow *et al*. 1997; Sudlow *et al.* 1998). However, as more Randomised Control Trials (RCTs) emerged with supporting evidence for the use of warfarin over aspirin, so too did the notion of clearer risk-factors for stroke and hence the production of the early guidelines. Guidelines seen in the period between 1991 to 1998 nevertheless had different measures of stroke-risk and advice for treatment including antiplatelets and anticoagulants, detailed collectively as the use of antithrombotic therapies in the prevention of stroke. Later still, the development of the $CHADS_2$ stroke-risk tool (Gage *et al*. 2001) emerged to enable the clinicians to accurately assess their caseload for stroke-risk[1]. This was followed by an expanded tool, the CHA_2DS_2VASC risk-score (Lip *et al*. 2010), which was developed to exclude patients at low-risk for the need of treatments[2].

[1] $CHADS_2$ is an acronym for patients scored with (C) Congested heart failure (1 point), (H) Hypertension (1 point), Age > 75 years (1 point) and prior Stroke (2 points) with points that create a score indicating an annual stroke-risk.

[3] CHA_2DS_2Vasc is an updated score based upon the acronym (C) Congestive heart failure (or Left ventricular systolic dysfunction) (1 Point), (H) Hypertension (1 Point), (A2) Age >75 years (2 Point), (D) Diabetes Mellitus (1 Point), (S2) Prior Stroke or TIA or thromboembolism (2 Points), (V) Vascular disease (previous MI, peripheral arterial disease or aortic plaque) (1 Point), A: Age 65-74 years (1 Point), Sc: Sex category (female gender) (Points: 1).

In this period, there was also the introduction of the HASBLED (Pisters *et al*. 2010) and HEMORRHAGES (Gage *et al*. 2006) bleeding-risk tools which were designed to quantify bleeding-risk risk and to allow clinicians to make judgements that were more balanced on the risk of bleeding with the risk of stroke. Furthermore, for the first time, guidelines in this period now favoured the use of OAC, leaving no role for the antiplatelet drugs in the antithrombotic management of intermediate to high stroke-risk (Camm *et al*. 2012). Soon after this, further amendments followed in the guidelines which recommended that the DOAC drugs were to be considered as first line treatment over warfarin (Skanes *et al*. 2012). Furthermore, there would now be no role at all for Anti-Platelet drugs (APLs) in any risk category. Finally, in the most recent studies, the CHA_2DS_2VASC risk-score became the preferred stroke-risk tool for clinicians to use. The stroke-risk tool's acceptability was evident due to it being a practical and effective method to identify AF patients most at risk of stroke, and who would most benefit from OAC (Coppens *et al* 2013).

1.4 General-practice and OAC management.

Historically, general practitioners had no formal agreement to provide any AF or OAC services other than to provide ongoing repeat prescriptions and general medication reviews. However, two main factors affected the general-practice engagement with OAC for AF patients. Firstly, in 2013 UK, general practitioners became incentivised through payments via the Quality and Outcomes Framework (QOF) and encouraged GPs in identifying AF patients, thus enabling the creation of an AF caseload registry. Secondly, incentivization also included payments for the proportion of AF patients on antithrombotic treatments (including either aspirin or warfarin) (British Medical Association & NHS Employers 2006). In 2015, QOF criteria and payments changed yet again to include reimbursement for the treatment of all AF patients with a CHA_2DS_2VASC risk-score of two or more (British Medical Association & NHS Employers 2015). Each QOF change on general-practice was found to lag the national guidelines by up to 18 months and this affected general-practice OAC change. Secondly, the evolution of local clinical commissioning groups (CCGs) in the UK has further resulted in the development of various locally enhanced services (LES). These are voluntary local service agreements whereby individual general-practices; general-practice consortia or

independent contractors can apply to manage specifically designed clinical systems. One such LES was developed to offer payment for providing OAC services in primary care settings (Department of Health 2011). Evolving the general-practices' roles in stroke prevention, including that of increasing interventions around OAC services locally, has involved a cultural shift in OAC provision. This cultural shift also relies upon the team-working between GPs and nurses who organise and manage all aspects of clinical work towards the common goal of providing high quality care. However, most of the evidence available to-date about the management of OAC, relates to former, secondary care established OAC services, and there is a paucity of evidence examining how general-practices are responding to the changing demands of AF and its associated stroke-risk management.

In summary, there is now greater awareness within general practice about both the importance of AF and the role of OAC in reducing the risk of stroke. GPs, being the lead clinicians in general-practice, and their nursing teams are now expected to deliver stroke-risk reduction measures using OAC in this increasingly prevalent disease. Managing stroke-risk using OACs is clearly a complex undertaking, but with historically high levels of underuse in the traditional models of warfarin-based, secondary care led services. It is unclear how general-practice practitioners are taking-up the challenge of AF stroke-risk management against a background of wider options of OAC drug choice. This thesis aims to explore the factors affecting effective and ineffective OAC use currently, specifically in general practice. This includes, examining an evolving awareness of the need to expand practice to include new OAC services, identifying what specific general-practice contextual barriers and facilitators to OAC use exist, and what measures are taken to overcome these challenges to OAC use.

1.5 Thesis aim:

This thesis aims to construct a theoretical model which explains how general-practices could improve their use of OACs to reduce stroke-risk in AF patients.

1.6 Thesis objective:

To identify possible elements for an intervention that could increase the use of OAC in general practice for AF patients at risk of stroke.

This thesis is in four parts, each focussing on specific research aims and objectives. Part 1 will aim to establish the known findings relating to the nature of, and factors relating to, OAC used in general-practice settings. Part 2 will aim to develop an in-depth understanding of the nature of OAC use in a large general practice setting. Part 3 will aim to critically examine the introduction of a new OAC service within a single general practice setting and explore the factors that affected its embedding into practice. Finally, part 4 will aim to develop and present the factors for a theoretical model which explains how general-practices could use OAC effectively to reduce the stroke-risk in AF patients.

Part 1: Aim: To identify the current evidence on the nature of, and factors relating to, OAC use in general-practice settings.

Objectives**:** 1**:** To review and synthesise the literature concerning OAC use in general-practice settings.

2: To identify any factors which promote or hinder OAC use in AF patients in general-practice settings to inform an initial hypothesis that proposes how OAC is used in general-practice settings.

Part 2: Aim: To develop an in-depth understanding of the nature of OAC use in a large general practice.

Objectives**:** 1: To describe and summarise the AF patients' clinical pathways, including clinical presentation, diagnosis and treatment decisions, involving OACs in a large general practice.

2: To describe the nature of OAC use and to identify the factors that promote or hinder OAC use for AF patients in a large general practice.

3: To further develop the initial hypothesis that proposes how OACs can be used effectively within a general-practice setting.

Part 3: Aim: To critically examine the introduction of a new OAC service within a large general-practice setting and to explore the factors that affected its embedding into practice.

Objectives: 1: To explore how OAC practice was introduced and how change

affected practice in a large general-practice setting, identifying the key roles required for this change of practice.

2: To describe the organisational and system factors that are required to enable OAC change of practice in the general-practice setting.

3: To identify specific factors which promoted or hindered the embedding of OAC use in a large general practice.

4: To further develop the hypothesis that proposes how OAC can be operationalized effectively within a general-practice setting.

Part 4: Aim: To construct a theoretical model which explains how general-practices could use OAC effectively to reduce the stroke-risk in AF patients.

Objectives: 1: To discuss the model factors that explains how general practices might use and manage OACs to reduce the stroke-risk in AF patients.

2: To describe the key components in a model to explain OAC use for AF patients at risk of stroke in general-practice.

3: To explain this model by presenting a synthesis of the findings that have emerged throughout this thesis.

4: To propose possible elements for an intervention for general-practice and discuss how this model might be used to improve the uptake of OAC in AF patients at increased risk of stroke.

1.7 Thesis outline.

Chapter 1 has presented the background for this thesis, outlining the problem of stroke, describing the mechanism of AF as a key risk-factor for stroke. The role and utilization of stroke-risk-reduction using OACs in AF has been outlined. This chapter has also highlighted the role of general-practice changes in the organisation of care delivery of OAC for the purposes of managing the risk of stroke in patients with AF. The rationale for the exploration of the factors specific to OAC use in general-practice settings has also been presented.

Chapter 2 will present a structured literature review, specifically addressing the use of OAC in treating AF patients within general-practice settings. Although underuse of OAC is commonly addressed in the literature, how this underuse directly relates to the role of the general-practice and what may be done to improve it, is not understood. Therefore, a review of the current literature will aim to establish the known findings relating to the nature of, and factors relating to, OAC used in general-practice settings.

Chapter 3 will describe the philosophical and methodological underpinnings for this thesis, including the role of this researcher and the background context of the study programme. The motivation for undertaking this programme of research is detailed. The role of the insider-researcher in the research process is also outlined.

Chapter 4 will present general-practice use of OAC for the Prevention of Stroke 1 (GAPS1). The first part of a case-study maps historical OAC practices and antithrombotic rates relating to the AF patients within a large general-practice caseload. As general-practices are now encouraged, via incentivization, to engage in AF and stroke-reduction care, it is important to establish what factors have previously influenced OAC uptake or otherwise in this context. Therefore, an investigation is required aiming to develop an in-depth understanding of the nature of OAC use in a large general-practice setting.

Chapter 5 will present general-practice use of OAC for the Prevention of Stroke 2 (GAPS2). This is the second part of the case-study examining the implementation of a new OAC service within a general-practice. An assessment, relating to the introduction and development of an OAC service within the case-study is made, with the aim to critically examine the introduction of a new OAC service within a large general-practice setting and explore the factors that affected its embedding into practice.

Chapter 6 will present a model that explains how general-practices could use OACs effectively to reduce the stroke-risk in AF patients. A synthesis of findings will be used to discuss the possible elements for an intervention to improve the uptake, and use, of OAC in general practice for stroke prevention in AF patients. Developing and engaging in OAC care in general-practice settings is currently voluntary and driven only by incentivization. Therefore, knowledge about all the previously discussed factors that promote or prevent OAC use in general-practice settings needs to be developed into a potential model, enabling

successful dissemination of OAC care into general-practice. The final aim is therefore, to develop and present the factors for a theoretical model which explains how general-practices could use OACs effectively to reduce the stroke-risk in AF patients.

Chapter 7 will present a discussion about the key findings including proposals for factors necessary for an OAC intervention. It will also highlight suggestions for clinical practice and the limitations of this thesis, whilst outlining suggestions for future research in relation to the findings presented.

Chapter summary.

This background chapter has highlighted the importance of stroke as a key cause of mortality, morbidity and burden on the modern healthcare system in the UK and worldwide. AF was identified as an increasingly common risk factor for stroke whose impact can be effectively reduced by the correct use of OAC therapies. It has established that there is a projected increase in the size of the older population, who will experience both an increase in AF (as a risk-factor for stroke) and suffer a greater number of strokes without OAC. There is also a historic underuse of OACs driven by current OAC management systems.

A cultural shift in OAC provision from secondary to primary care has been outlined. This chapter has also depicted how general-practice role(s) continue to evolve to incorporate the expectations of stroke prevention responsibilities. Reference has been made here to a body of evidence, mainly based within the secondary care systems, which does little to explain how OAC is used from the general-practice perspective in the UK. Finally, this chapter clearly outlines the need to explore the complex nature of OAC use for stroke prevention in the AF population from a general-practice perspective in a changing healthcare environment.

Chapter 2.

2. Literature review.

The previous chapter outlined the background to this thesis, explaining how managing stroke-risk using OAC in patients with NVAF is a complex undertaking; traditionally been undertaken mainly in secondary-care, although still underused.

In this chapter, I will present a review of the literature which represents an original contribution to knowledge specific to how general practices provide OAC care of NVAF patients. The review is of significance to all clinicians in general-practice settings who seek to understand OAC use relative to AF patient caseloads.

It is unclear how general practices are responding to the challenge of addressing this complex treatment, and what barriers and facilitating factors might affect OAC use in this setting. Therefore, a comprehensive literature review was needed to explore understanding about OAC use within general-practice, and to critically evaluate and summarise factors that may promote or prevent the use of OAC. In this chapter, I will present the details of this literature review. The chapter comprises four sections: the aim of the literature review, the methods used to find and evaluate the literature, the findings of the review, and finally, a summary and discussion of key findings.

2.1 Aim of the review.

To critically evaluate the current evidence about how OAC has been used in general practice for the prevention of stroke in NVAF patients, examining and assessing any barriers and facilitators to its use.

Objectives:

- To identify the levels of OAC therapy and the key factors affecting levels of OAC use in patients with NVAF at the patient, clinician and organisational levels in general-practice settings.
- To explore potential reasons for non-use of OAC in patients with NVAF in general practice.

2.2 Methodological approach to the review.

A scoping review conducted in 2013 was used to identify key papers that discussed OAC use in relation to AF and stroke prevention. Furthermore, it enabled the identification of the

gaps in understanding the nature of OAC use in general practice that led to the present review. This review was therefore necessary to explore these gaps in current knowledge and it would also form the foundation for further research that I would undertake in this thesis.

Many methods for undertaking a literature review exist which have been classified against the aims of the review and the methodologies employed (Grant and Booth 2009). So, selecting a suitable method for undertaking this literature review involved me reflecting on the aims of this thesis. Namely, it was one of identifying, assembling and analysing the available research into OAC use, in contrast to, for example, reviewing the effectiveness of different types of OAC. Research evidence in practice has however been increasingly focused upon effectiveness, using systematic review methodologies and meta-analysis (Evans & Pearson 2001). These methodologies are often based solely upon the analysis of randomised controlled trial (RCT) data producing a hierarchical evidence base which excludes other types of research evidence, such as, observational studies that may be more relevant to clinical practice (Evans & Pearson 2001). A systematic review is considered a gold-standard approach for investigating intervention studies that address a pre-specified research question and which uses specific systematic methods to identify relevant research in a way that reduces bias and increases the validity of findings (Green *et al*. 2008). Systematic reviews are also recommended for observational type studies under certain circumstances. However, the aims of this literature review could not be addressed by solely focusing on intervention studies. Furthermore, the types of studies and data that emerged from the initial scoping searches meant that a review type was required that would be able to include multiple types of studies, with varying methodologies and provide a rigorous strategy that could reduce bias. In accordance with Grant and Booth's typology of literature reviews (2009), the critical review best described the components of the literature review used in this thesis and best "fits" the underlying critical realist standpoint, to be discussed later in chapter 3. However, there were also similarities with the characteristics of a "mapping review" which are also used to explore gaps in the literature in order to signpost further research (Grant and Booth 2009). As such, the integrative nature of the review included diverse methodologies, and empirical and theoretical evidence that can enabled further research to inform clinical practice (Whittemore & Knafl 2005). Therefore, the critical review approach was selected as the method for this review.

2.2.1 Search strategy.

An extensive and systematic search strategy was required to obtain as much of the possible known information in relation to the research objectives (Dickson 2000). The searching of both published and non-published information aimed to reduce possible publication bias (Jadad 2000), and here, it included searches of appropriate databases, electronic and paper journals, and grey literature sources. This structured literature search was conducted over three steps: Several keywords were examined and selected for searching electronic databases; Hand-searching of key and relevant papers was done in case the papers were not listed on one of the searched databases; and papers of interest were assessed against inclusion/exclusion criteria.

2.2.2 Formulating the search.

Formal searching of the academic literature began with a scoping search of the electronic database Ovid HealthSTAR (Ovid.com 2017). The database enables searching of multiple field types [3] including subject headings, free text and medical subject headings (MESH). The initial search terms used reflected the aims of the review which were structured around four factors: stroke, AF, OAC and general practice. Using these factors, the initial search of the database involved searches in both "*subject heading*" and "*text*" which revealed multiple MESH headings.

2.2.3 Refining the search strategy.

Papers of initial interest were read, and their MESH terms noted which helped to refine the formal database searches. Ovid HealthSTAR also has the facility to "*explode*" MESH terms to include any related description and terms of expression used. The MESH terms of the initial papers of interest were noted and then used to further refine the key terms relating to four aspects of this thesis (stroke, AF, OAC and general practice). The Boolean search operators "*and*", "*or*" and "*not*" were used to create a broader search[4].

[3] http://ospguides.ovid.com/OSPguides/hstrdb.htm#search

[4] http://ospguides.ovid.com/OSPguides/hstrdb.htm#advanced

A broad search strategy was used initially using the following search headings:

Anticoagulation > Warfarin > Coumarin

Stroke (and exploded subheadings including Cerebral Vascular Accident [CVA])

Cardiovascular disorders (includes CVA)

Atrial fibrillation >Arrhythmia

Clinicians (and sub-headings)

The search term stroke was chosen as the preferred term for apoplexy and is used formally by the World Health Organisation's International Classification of Diseases (ICD), with the initial ICD-9 code agreed in 1990 to include synonyms such as CVA (Norrving *et al*. 2013), even though the terms Apoplexy and Cerebral Vascular Accident are no longer in use in clinical practice.

This search was then repeated with duplications removed across subsequent databases.

The MESH headings commonly used within the relevant literature previously found during the scoping searches were checked against the hits retrieved for accuracy. Combinations of the MESH headings listed below were used to facilitate further searching for relevant literature of databases listed in section 2.6.

Initial MeSH headings used:

Warfarin/contraindications; Warfarin/therapeutic use; Administration, Oral; Anticoagulants/therapeutic use; Atrial Fibrillation/drug therapy; Barriers; Facilitators; Communication; Decision-Making; Stroke/prevention & control; Guideline adherence.

Searching commenced in June 2013 and the process of searching, abstract analysis and accessing papers, was undertaken over a period of 12 weeks. Electronic alerts were also used to identify abstracts of interest with the key words of "*warfarin, anticoagulation, AF, general-practice*" to compile Medline alerts that were e-mailed weekly for the duration of the study program, with the intention of uncovering possible new relevant studies. Articles of interest were sought in full text from NHS libraries.

2.2.4 Electronic databases.

Databases were used with access through UCLAN's electronic library service and the National Health Service's information and knowledge services that included:

1 British Nursing Index (BNI).

2 CINAHL.

3 The Excerpta Medica database (EMBASE).

4 The Healthcare Management Information Consortium (HMIC).

5 MEDLINE.

6 PsycINFO.

7 Prospero.

These cover all the major databases for health research. Medline and CINAHL were the first two databases searched due to their comprehensive coverage of included medical and health related research. Similarly, the remaining databases were used to gain more specialised materials such as, major pharmacological and biomedical literatures (EMBASE), Nursing (BNI), Healthcare Management Information Consortium (HMIC), Psycho-social research (PsycINFO) and systematic reviews (Prospero).

2.2.5 Grey literature sources.

Grey literature sources were searched for using the links below:

1 National Research Register (NRR) Archive. http://www.nihr.ac.uk/Pages/NRRArchive.aspx.

2 The National Institute for Health Research, Clinical Research Network Coordinating Centre Portfolio. (NIHR CRN CC) http://public.ukcrn.org.uk/search/.

3 British Library EThOS (Electronic Theses Online Service) http://EThOS.bl.uk.

The above grey literature sources were searched to determine if any unpublished papers existed, or if there was any research currently in progress.

Citation tracking.

Key papers were explored by searching references of interest. A cross-reference check against the hits was performed from the previous databases and electronic journals and revealed hits to uncover new papers.

2.2.6 Search results and documentation.

This search strategy produced a high volume of hits which required managing. Each of the electronic databases had an area for saving searches for reference. Copies of the searches were printed off and catalogued to prevent repetition of searches. These searches can be found in the appendices (Appendix 2, P.341). Publications found during the initial search were assessed for potential suitability from their title and abstract and irrelevant items were excluded but catalogued. Electronic alerts were applied to abstracts of interest with the intention of uncovering possible new relevant studies.

Articles that passed this initial assessment were then either retrieved in full-text through full text electronic journals, or requested, via the National Health Service's information and knowledge services.

2.2.7 Inclusion and exclusion criteria.

A previous scoping search revealed a vast number of potential papers that included a variety of research methods, aims and objectives and published in several languages. Therefore, inclusion/exclusion criteria were used to ensure that papers included here were relevant to the objectives of the review. The review was limited for time and other resources, so only papers available or easily translatable into the English language were included. Many papers that were previously scoped had some relevance to the aims and objectives of this literature review containing data pertaining to OAC use. However, others also contained data that had not differentiated between NVAF and VAF OAC use, the latter condition also being commonly treated with OACs, but usually managed under a secondary care expert, and therefore, not the focus for this review. It was important to include only papers which had evidence of possible factors of both barriers and facilitators to OAC use in general-practice. For this purpose, studies were included that had examined different factors negatively affecting the use of antithrombotic therapy in general-practice settings. Making decisions

about which patients are at most risk of stroke with NVAF, is also important, and many papers found in the scoping search failed to demonstrate this. I, therefore, only considered including studies that presented an identifiable stroke-risk description to be of greater relevance and greater quality in this review. RCTs were also excluded due to the questionability of relevance to the literature review aims and objectives, given their focus on interventions.

This study therefore only focuses on a restricted number of papers that included the following:

Inclusion criteria.

* Papers that contained data from general-practice or family practice.
* Papers that provided data about the use of OAC therapy for NVAF patients.
* Papers that reported factors that could prevent or promote OAC therapy.
* Papers which acknowledged specific factors for stroke-risk or assessed stroke-risk.
* Papers available in English.
* Papers that included primary care data, but, where it could be differentiated from secondary care data.

2.2.8 Study quality assessment.

The selected articles were assessed in full for their quality using the Critical Appraisal Skills Programme (CASP) quality assessment tools (Critical Appraisal Skills Programme 2018). These tools were chosen because there were a range of tools available to address the expected heterogeneity of research methodologies, which would be extracted by the searches. No study was excluded on the grounds of study quality. The quality assessment process happened before any other data extraction took place and was used to inform data analysis.

2.2.9 Approach to data extraction.

A scoping search had revealed multiple levels of heterogeneity in relation to study methodologies, contexts, outcome measures, and quality. The methodological differences

employed across the studies resulted in a variety of OAC use reporting. This meant that few studies could be directly compared. Despite this, the variety of OAC use reporting was important to analyse as it might highlight different factors that would build a picture of how OAC has been used in primary-care.

To support the data extraction and analysis in this literature review, a methodological framework was needed, that allowed for an examination of the available studies. These studies involved differing methodological approaches and research outcomes and presented pertinent OAC use data in different ways. Therefore, the range different CASP tools provided the flexibility of methods quality assessment that was used as the basis for data extraction.

Data was therefore extracted from the selected papers in accordance with a quality assessment framework(s) (CASP) which suggested step-by-step data fields necessary to assess quality. For example, the cohort study tool was arranged by 3 sections (Are the results of the study valid? What are the results? Will the results help locally?) and then headed by twelve main questions scrutinising the quality of the study's methods and reporting. Using the CASP framework also helped to organise the data retrieval process in a consistent manner and involved four fields for data extraction (study demographics, study methods, key study data collected, study results OAC use data).

The first three subsections of data extraction using this method related to the study characteristics including those depicted in Table (3). This data was extracted sequentially in alphabetical order of the authors of the papers retrieved which enabled me to pragmatically organise the extent of data to be extracted and managed. The final two subsections of data extraction included data relating to OAC use and statistics that related to the likelihood or otherwise of OAC use that might represent barriers and facilitators to OAC use. To appraise the extracted data, the results section presents the findings by year of publication and in the context of the contemporary guidelines or expert opinion that authors often quoted as a reference point to their studies.

Undertaking data extraction involved identifying the pertinent data relating to OAC use for retrieval. Electronic data extraction sheets were constructed using CASP quality headings along with the fields of focus for this study (Table 3). However, due to the various study

types, methods and outcomes, I needed to attempt standardization of the data extraction form. This was to ensure rigour by improving validity and reliability of the process (Higgins & Deeks 2011). The data extraction sheets were piloted on a selection of ten papers and amendments were made to ensure pertinent data was captured. The development of the data extractions sheets was then undertaken in conjunction with discussions during research supervision.

Eligible papers were read in full and authors contacted where original important data was missing from the published papers. Data was extracted and then transcribed onto spreadsheets in Microsoft Excel. This process was repeated for each of the retrieved articles individually until all the fields had been completed in the data extraction template.

Table 3. Key data types and subtypes extracted.

Key data types.			
Study demographics.	**Study methods Listed by:**	**Study data collected by:**	**Study results OAC use data by:**
Subtypes.			
• Author. • Year. • Study type.	• Study aims. • Methods. • Study period. • Ethical consideration. • Sampling. • Exclusion. • Limitations discussed?	• Contraindications listed. • Stroke-risk factors listed. • Statistical tests used. • Sample specific characteristics. • AF diagnosis/type. • Warfarin use measured by.	• OAC status. • Age. • Under treated. • CIS. • Stroke-risk. • OAC barriers. • OAC facilitators.

2.2.10 Data analysis.

SPSS was used to collate and count the frequencies of the factors that emerged from the literature reviewed and a narrative analysis was made of the collated findings. Initially, descriptions of the methods used in the papers were made. Similar constructs are presented as frequencies. However, sometimes it was necessary to attempt to group non-identical constructs together to form new groups. In the previous scoping search, I had identified that papers often reported factors very differently. For example, studies that reported OAC by age, often used a variety of age fields, subdivided by other factors such as co-morbidity, contraindications and gender. I therefore attempted to construct similar fields where possible, which would enable frequency of OAC use within the depicted groups.

2.2.11 Search history.

The search strategy combined key words relating to OAC use in general-practice. Individual databases were searched using the same pattern of search terms, beginning with MEDLINE followed by CINAHL, EMBASE, HMIC, and PSYCH INFO. On completion of these searches, a secondary combined search was undertaken to remove duplicates. The resulting search trails (Appendix 2, P.341) revealed 686 non-duplicated abstracts of interest, which are depicted in Table 4 in order of the retrieved searches. Alerts, based on these searches, also produced a further 21 new articles, totalling 718 articles of interest.

Table 4. Results of abstract searches.

Database.	**Total abstracts retrieved.**
EMBASE.	290
MEDLINE.	231
CINAHL.	91
PSYCH-INFO.	40
HMIC.	34
Grey literature.	1
Alerts.	21
Reference lists.	10
Total	**718**

2.3 Search results.

This section describes the selection of papers that were used in this literature review and is presented as a PRISMA flow chart (Moher *et al*. 2009). The search strategy revealed an initial 697 papers with a further 21 articles selected via adding an alert process to Medline. This resulted in a total of 718 papers, which after applying inclusion criteria, resulted in 70 retrieved papers to be included within the following review (Figure 3.)

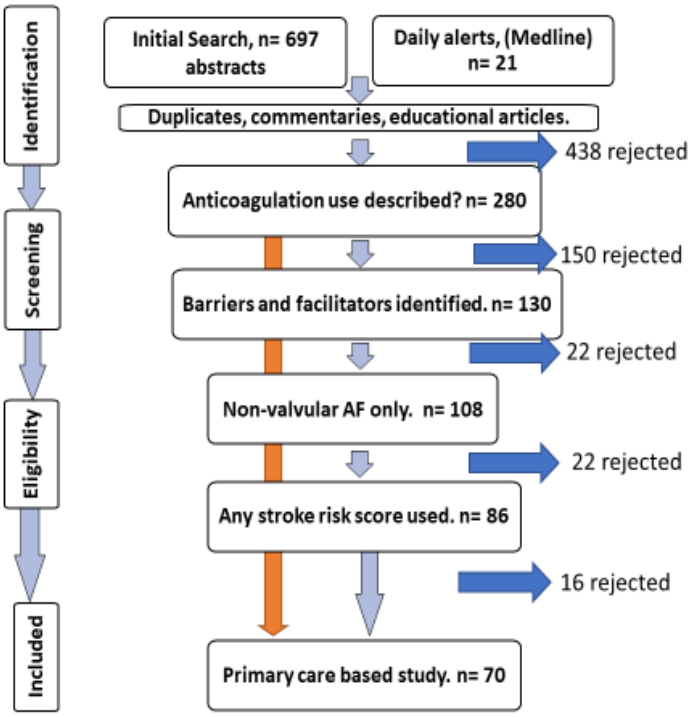


Figure 3. PRISMA flow chart of retrieved papers.

Papers were rejected if they failed to meet the inclusion criteria above, were duplicated, presented data which had already been published, or that only presented commentaries or discussions about AF, such as focused updates.

The papers for inclusion are listed in Table 5 identified by title, year published and search origin. Medline was the first database that I searched locating the majority 25/49 (51%) of the papers that I included. However, a search of the reference lists of the valid papers recovered also enabled the identification of a further eleven of the included papers. Further studies emerged using an alert process that I applied to the initial searches used, finding a further 21/70 (30.0%) of the included papers here. At the end of my research program I undertook a reassessment of the literature available since the time of the initial searches. Employing the same strategy, I found no new studies, which I attribute to the alert system that I used. In this section, I have described the steps that were undertaken to search and collect the papers required for this review. In the next sub-section, a description of the methodologies is presented, that were used in the studies selected for inclusion in this review. This is important, as the outcomes that were reported are of interest, and all have

different origins that impacted on the meanings of the reported OAC use, and thus, my interpretations later in this review.

2.3.1 Origin and year of retrieved papers.

The papers retrieved were published between the dates 1997 to 2018. Table 5 shows how the numbers of relevant papers increased over time. Over the last three decades, the period of the last eight years (2010 to 2018) produced 43/70 (61.4%) of all the papers. The period of 2012 to 2014 produced the peak number of 19/70 (27.1%) of the papers, which seemed to correspond to the recognition from the World Health Organization, that AF is a growing global problem (Chugh *et al*. 2013). For the UK general-practice set papers, this most likely represents the increased focus on the expanded role of the general practitioner in this clinical area.

There was often a lag between the collection of data and publication, ranging from 0 to 9 years, with a mean interval of 2.5 years. Some of the included studies omitted the dates when data was collected relative to the publication date (13/70 18.6%). Of the papers that did include the dates of data collection, most were published some 2 (14/70; 20.0%) or 3 (12/70; 17.1%) years later.

Table 5. Included studies: Title, publication year and origin of retrieved paper. N=70

Author.	Year 1990-99.	Primary Source.	Author.	Year 2000-09.	Primary Source.	Author.	Year 2010-2014.	Primary Source.	Author.	Year 2015-2018.	Primary Source.
Sudlow	1997	Medline	Samsa	2000	Medline	Mazzaglia	2010	Medline	Bahri	2015	Alert
Sudlow	1998	Medline	Whitford	2000	Cinahl	Lee	2011	Medline	Das	2015	Alert
Howitt	1999	Medline	Ceresne	2002	Reference list	Mashal	2011	Medline	Sabouret	2015	Alert
Mon-Son-Hing	1999	Medline	Ruigómez	2002	Reference list	Meinertz	2011	Medline	Shantasila	2015	Alert
Oswald	1999	Medline	Lipman	2003	Psych-Info	Cowan	2012	Medline	Isaew	2016	Alert
Smith	1999	Reference list	Blich	2004	Embase	Ewan	2012	Medline	Kirley	2016	Reference list
White	1999	Reference list	Dantas	2004	Reference list	Holt	2012	Medline	Adderley	2017	Alert
			Deplanque	2004	Reference list	Scowcroft	2012	Medline	Apenteng	2017	Alert
			Anderson	2005	Medline	Abdul-Rahim	2013	Medline	Ashburner	2017	Alert
			Pusser	2005	Medline	Brandes	2013	Alerts	Ding	2017	Alert
			Simpson	2005	Medline	Carlsson	2013	Medline	Jain	2017	Alert
			Boulanger	2006	Medline	Clua-Espuny	2013	Reference list	Lacoin	2017	Alert
			DeWilde	2006	Medline	Forslund	2013	Medline	Leung	2017	Alert
			Dinh	2007	Medline	Kassianos	2013	Medline	Mazurek	2017	Alert
			FALSTAF study group	2007	Reference list	AbuDagga	2014	Medline	Tomlin	2017	Alert
			Murphy	2007	Reference list	Borg-Xuereb	2014	Alert	Viscogliosi	2017	Alert
			Gallagher	2008	Medline	Dreishulte	2014	Psych-Info	Adderley	2018	Alert
			Jacobs	2009	Medline	Hannon	2014	Alert	Murphy	2018	Alert
			Ogilvie	2009	Medline	Johansson	2014	Medline	Robson	2018	Alert
						Khan	2014	Medline	Schwill	2018	Alert
						O'Brien	2014	Medline	Willey	2018	Alert
						Robson	2014	Medline			
						Valentinis	2014	Alert			

The retrieved papers reflected studies originating in numerous countries (Table 6), the most common of which was the United Kingdom (UK) (32/70; 45.7%) which included papers based specifically in England and Scotland.

Table 6. Frequency of study country of origin.

Study country of study origin (frequency (%).								
Israel.	Spain.	Italy.	Canada.	Sweden.	France.	Other.	USA.	UK.
2 (2.9)	**2 (2.9)**	**3 (4.3)**	**4 (5.7)**	**4 (5.7)**	**5 (7.1)**	**7 (10.0)**	**11 (15.7)**	**32 (45.7)**

2.3.2 Study methods found.

All studies were listed as described within the papers and counted only once (Table 7). However, not all the studies had an author-reported description of the study type. I assigned a study typology where it was not clearly defined. This involved deciding if a study was prospective or retrospective OAC use data. (Table 7). This was deemed important in interpreting the findings of the studies. For example, in retrospective studies which collected or analysed data from secondary sources such as databases. In these studies, primary data was collated for clinical reasons, was reliant on the accuracy of data entry methods at source and lacked contextual data. Thus, data used in these studies may not have had the same rigour compared to data collected for primary care research purposes and therefore was open to many forms of bias. Whereas, prospective studies might have had greater influence on the data that they collected, measured and analyzed, to increase research rigour. However, four studies used mixed methods that included a retrospective analysis of GP records or database data and prospective interviews with wither patients of GPs (Deplanque et al. 1999; FALSTAF Study Group 2007; Hannon, et al. 2014; White et al. 1999). Heterogeneity was apparent amongst the papers selected and took many different forms.

Table 7. Study methods used.

Study type.	Total.
Retrospective cohort study.	47
Prospective cohort study.	17
Qualitative study.	4
Qualitative meta-analysis.	1
Systematic review.	1

Most studies were described as cross-sectional 49/70 (70%), retrospective 47/70 (68%), or prospective cohort 17/70 (24.6%) studies, and a further 8/70 (11.4%) papers were longitudinal in nature. Of the papers that used a prospective approach to data collection, all but four of these (Sudlow *et al.* 1997; Sudlow *et al.* 1998; Anderson *et al.* 2005; Deplanque *et al.* 2014), included both a retrospective review of medical records and interviews with clinicians. Further papers reported a prospective approach to data collection, the first of which describing the analysis of records with a view to patient AF screening (Clua-Espuny *et al.* 2013). None of the papers that are reported in this review included RCTs as no effectiveness trials were included in the search.

2.3.3 Data sources found.

The types of data analyzed were collected from different sources which are depicted in Table 8. This was deemed important to recognize, as each method had its own strengths and weaknesses. For example, some studies use clinical and administrative databases which enabled them to include large amounts of population data attributable to many patients and GP practices. This approach to data collection then enabled researchers to develop models of specific factors to show likelihood of OAC treatments (Cook & Collins 2015). However, the same studies were not able to differentiate why some patients with specific factors were treated and others were not, and/or, understand what influence or role the general practice had on the OAC treatment outcomes depicted in the data.

Table 8. Study Data analysed.

Data analysed.	Single GP practice records (SGP).	Database (DB).	Interviews (I).	Mixed-methods (M).	Other.
	9	**37**	**5**	**13**	**8**

To attempt to understand this, qualitative methods were more illuminating. Similarly, some methods involved retrospective analysis of data, where others used prospective and mixed methods. Analyses based upon retrospective data collected were limited by the way others had Read-coded and collected that data, including diagnosis Read-codes and prescription issues. Alternatively, prospective studies that selected patients, and thus generated data, may have produced more reliable assessments and diagnoses. Most papers retrieved used methodology that included the use of clinical databases, whilst nine papers used data held

directly in the electronic held GP records. Studies that were classified as mixed-methods used combinations of interviews with patients, GPs and GP records. A further 6 studies incorporated only qualitative methods, whilst one further study was included a systematic review of qualitative papers (Borg-Xuereb 2014).

2.3.4 Stated aims found.

The stated aims, where published, are presented in Appendix 3 (P.301). The published aims were examined and collated to form groups (Appendix 4, P.304) and most papers had more than one single aim. A wide variety of aims existed across the papers retrieved, totalling 18 individual factors, the most common of which was to investigate the OAC used. Only one paper specifically sought to examine contraindications and OAC use (Adderley *et al*. 2018). One further paper also examined AF type and OAC use (Isaew *et al*. 2016). Two papers aimed to investigate specifically bleeding-risk and OAC use (Scowcroft *et al*. 2012; Ding *et al*. 2017), knowledge of which is vital in OAC decision-making. Four papers addressed OAC use in conjunction with a study to change OAC management in practice (Oswald *et al.* 1999; Robson *et al.* 2014; Das *et al.* 2015; Shantasila *et al.* 2015). On reflection, this may have occurred because of the decision to exclude RCTs. If these had been included, it may have led to inclusion of studies designed to evaluate interventions to improve OAC clinical GP practice.

2.3.5 Variables of the studies included.

In accordance with the heterogeneity of study aims and methods used, the review also found that papers included a wide variety of study variables (Appendix 5, P.349). Papers that employed quantitative methodologies had a variety of descriptions of the inclusion and exclusion criteria, sampling methods, contraindications to OAC definitions and stroke-risk definitions used. Papers that used qualitative methodology generally used individual interviews of either GPs or NVAF patients.

2.3.6 Exclusions and inclusion used.

Sixty-five papers were examined for this section as to the type and frequency of inclusions and exclusion criteria that were described (Appendix 6, P.352). Sixty-five, unique exclusion and inclusion criteria, were found amongst the papers respectively, and most papers had

documented at least one exclusion criteria (49/65; 75%). Exclusions in some studies may be described as contraindications elsewhere. So, identifying the different exclusion criteria and contraindications became important relative to the objectives of this review and to the next stages of this research program. For example, some studies excluded housebound patients (Abdul-Rahim *et al*. 2013), wheelchair bound or immobile patients (White *et al*. 1999; Viscogliosi *et al*. 2017) or nursing home patients (Smith *et al*. 1999; White *et al*. 1999; Anderson *et al*. 2005; Abdul-Rahim *et al*. 2013; Hannon *et al*. 2014), all of whom are common on GP caseloads. Therefore, there may be limited data for these groups.

2.3.7 Sampling used.

Convenience sampling against the inclusion and exclusion criteria was performed in several ways according to the published descriptions (Appendix 7. P.354). Of the papers where sampling was described (n=65), most papers included all AF patients (48/65; 73.8%). A form of random sampling was then applied in six of the studies (6/65; 9.2%). In papers where all eligible patients were included, several methods were used to identify the presence of AF. The GRASP-AF (Primis 2017) tool was used in three studies (Cowan *et al.* 2012; Das *et al.* 2015; Shantasila *et al.* 2015), whilst six studies described using consecutive patients as their main type of patient sampling (Deplanque *et al.* 2004; Dinh *et al.* 2007; FALSTAF study group 2007; Meinertz *et al.* 2011; Ewan *et al.* 2012; Hannon *et al.* 2014). A further six studies identified their samples using electrocardiogram (ECG) screening (Sudlow *et al.* 1998; Smith *et al.* 1999; White *et al.* 1999; Anderson *et al.* 2005; Clua-Espuny *et al.* 2013; Ding *et al.* 2017) and three further studies used GP selected patients (Hannon *et al.* 2014; Apenteng *et al.* 2017; Viscogliosi *et al.* 2017).

2.4 Reported study findings.

2.4.1 Identifying AF patients.

It was important to acknowledge how the studies established or verified an AF diagnosis as it could potentially influence the validity of the study in question. This data is collated in Appendix 8 (P.356). In all the papers that required the identification of AF, there was no discussion as to where the GP AF Read-codes originated or who made the actual AF diagnosis. Verification of AF diagnosis was determined in all prospective studies. However,

in the papers that directly examined the OAC use of patients (n=59), six studies (6/59; 10.1%) failed to state how they identified AF in their study populations (Whitford *et al.* 2000; Blich *et al.* 2004; Simpson *et al.* 2005; FALSTAF study group 2007; O'Brien *et al.* 2014; Sabouret *et al.* 2015). Most papers employed AF Read-coding, retrieved from within medical records to identify the AF sample (36/59; 61%). The specific Read-codes used were not specified in 42.3% of the papers (25/59), one study used the ICD10 Read-code and ECG to identify the sample (Ding *et al.* 2017). Samsa *et al.* (2000) used an ECG method and Read-codes that were not stated. Two further studies employed the GRASP-AF tool which explored practice Read-codes to identify AF patients (Mazurek *et al.* 2010; Das *et al.* 2015). In both studies, the Read-codes searched were not described. The ICD-9 AF Read-code was reported as being used in eight papers. Similarly, the ICD-10 AF Read-code was used in a further two papers (Carlsson *et al.* 2013; Forslund *et al.* 2013). ECG data was used to identify the AF sample in 27% of the papers (16/59). Finally, two papers reported that the AF sample was self-reported by the GP without stating how the AF patients were identified (Oswald *et al.* 1999; Dinh *et al.* 2007).

Paroxysmal AF (PAF) is estimated to account for up to one-third of all AF cases, and is often asymptomatic, but shares the same stroke-risk as permanent AF (Dilaveris & Kennedy 2017). Furthermore, there has been a historic difficulty in defining PAF and different attitudes to OAC management (Lip & Li Saw Hee 2001). This review found that in the papers that directly examined OAC use in AF patients, the type of AF was most frequently not reported (40/63; 63%). A further three studies only included "*chronic*" AF in their sample (Ruigómez *et al.* 2002; FALSTAF study group 2007; Gallagher *et al.* 2008). Sixteen papers did however report the types of AF within their studies (16/59; 27%). However, screening studies may have underrepresented the AF burden in their samples, and the studies that excluded PAF will have also underestimated the stroke-risk burden in their samples, as patients with PAF have been found to be much older and have higher CHA_2DS_2VASC risk-scores (Esato *et al*. 2017).

2.4.2 Identifying antithrombotic therapies used.

The studies included in this review contained data pertaining to "*antithrombotic drug use*" which included both OAC and APL therapies, using numerous methods for describing how antithrombotic usage data was collected (Table 9). However, 42% of the papers failed to

define the details of the methods that they used (27/64; 42%) to determine "*antithrombotic*" usage. Of the studies that did depict the antithrombotic drug use in their studies (17/64; 24%), this included same day point of assessment drug use (Deplanque *et al.* 2004); drugs used within the last 2 weeks of assessment (Smith *et al.* 1999); antithrombotic drugs used within the last 3 months (Ruigómez *et al.* 2002; Gallagher *et al.* 2008; Mashal *et al.* 2011; Bahri *et al.* 2013; Dreishulte *et al.* 2014; Isaew *et al.* 2016; Lacoin *et al.* 2017) with variation of 45 days (Ewan *et al.* 2012), six months (Cowan *et al.* 2012; Robson *et al.* 2014); up to 1 year (Abdul-Rahim *et al.* 2013) and up to 3 years since diagnosis (Kassianos *et al.* 2013).

Table 9. Criteria for antithrombotic therapy used.

Author.	Year.	Defining data about OAC use methods used.
Abdul‑Rahim.	2013	At least one prescription for warfarin or other VKA within the 1‑year period.
Bahri.	2015	Prescriptions in the last 90 days.
Cowan.	2012	A prescription for anticoagulant in the last 6 months (warfarin, Acenocoumarin, Phenindione, Dabigatran, Rivaroxaban and Apixaban).
Deplanque.	2004	Admission records, INR status.
Dreishulte.	2014	Prescriptions in the last 90 days.
Ewan.	2012	Prescription sheets *INR values with gaps up to 45 days with each category.
Gallagher.	2008	Prescription data held on database up to 90 days.
Isaew.	2016	Prescription for any anticoagulant drug (including warfarin, parenteral anticoagulants, other vitamin K antagonists and new oral anticoagulants) within 90 days prior to the index date or a clinical Read‑code indicating provision of anticoagulant therapy within 365 days prior to the index date.
Kassianos.	2013	Prescription data on the last 3 years or the latest 3 months with new NVAF patients.
Lacoin.	2017	Prescription data last 90 days.
Mashal.	2011	Prescription data INR values over last 90 days.
Robson.	2014	At least one prescription in the last 6 months.
Ruigómez.	2002	Prescription data 90 days.
Scowcroft.	2012	Prescription data ‑ first prescription for warfarin (if within 12months of diagnosis).
Smith.	1999	Self‑reported use by patients by supplying evidence of usual prescriptions taken in the last 2 weeks.
Tomlin.	2017	Patients with three or more prescriptions for these drugs in the previous 14 months or, in the case of warfarin, patients with more than 200 tablets prescribed in the previous 14 months.
White.	1999	Medication use was determined by direct review of all drugs each participant was taking at the time of the examination.
Willey.	2018	Patients with ≥1 pharmacy claim(s) for any OAC during the patient identification period, and a medical claim for an AF diagnosis on or within 90 days.

INR values were also collected and reported in one paper as a means of determining antithrombotic-use (Deplanque *et al.* 2004), yet this study failed to exclude patients taking warfarin for other reasons. A combination of INR and prescription data was used in two papers (Mashal *et al.* 2011; Ewan *et al.* 2012). Other methods used to identify

antithrombotic use described within the papers were, "*GP self-reporting*" (Sudlow *et al;* 1997; Oswald *et al.* 1999; White *et al.* 1999; Dinh *et al.* 2007), "*patient self-reporting*" (Smith *et al.* 1999), "*codes*" (Ceresne *et al.* 2002; DeWilde *et al.* 2006) and "*searching of free-text records*" (Valentinis *et al.* 2014). The potential fluidity in patient treatments may thus make reasonable comparisons about OAC use difficult. For example, patients may move between therapies pending decisions, and it was not clear if patients could be counted twice in different drugs groups. If so, it wasn't clear having experienced more than one treatment that each or which treatment would be counted.

2.4.3 Contraindications: constructs and reporting.

Papers which published contraindications data were indicating judgements towards a specific reason as either an absolute or potential reason not to provide antithrombotic treatments, which also affected study eligibilty criteria. Therefore, it was important to analyse the data relating to the stated contraindications, which proved to be another area of study heterogeneity.

In summary, forty papers listed contraindications to be taken into account in their data analysis (40/65; 61.5%). However, contraindications to OAC were not always described or discussed (22/65; 33.8%). A total of 55 unique descriptions of contraindications to OAC are described within the papers (Appendix 9, P.359). Furthermore, the plethora of published contraindications that have existed amongst the retrieved papers, and over time, indicated the potential for confusion that GPs may have when deciding treatment for patients. Furthermore, it is conceivable that absolute contraindications may have also been conflated, hence why many patients with "*contraindications*" were later found to be using antithrombotic therapy. A selection of published contraindications also varied by definition. These included, "*excessive alcohol use*", "*liver disease*", "*renal disease*" and "*bleeding-risk*". This makes direct comparisons of OAC use very difficult.

2.4.4 Stroke-risk scoring.

Identifying AF patients at risk of stroke has long been the focus of changing guidelines (Appendix 1, P.329) and is key to understanding why some patients with NVAF should be treated with OAC and others not. Despite this, seven of the 65 papers which described OAC

use, failed to describe or define the exact criteria they used to define their "*at-risk*" population (White *et al.* 1999; Ceresne *et al.* 2002; FALSTAF study group 2007; Murphy *et al.* 2007; Leung *et al*. 2017; Viscogliosi *et al*. 2017; Murphy *et al*. 2018) with only one study pre-dating the $CHADS_2$ score (White *et al.* 1999). Conversely, across all of the studies that offered "*at-risk*" descriptions (58/65; 89%), there were 13 stroke-risk factors identified (Appendix 10, P.361).

The two most commonly cited methods involved stroke-risk calculations, namely, the $CHADS_2$ risk-score and the CHA_2DS_2VASC risk-score. These two scoring systems accounted for 44.8% (26/58) and 46% (27/58) of all those cited amongst the papers respectively. However, a number of other stroke-risk factors were also published, but only appeared once each amongst the papers retrieved. For example, age appeared separately in three categories as an independent risk-factor for stroke, as "*Age greater than 60 years*" (Oswald *et al.* 1999), as "*Age greater than 65 years*" (Sudlow *et al.* 1997), and as "*Age greater than 75 years*" (Whitford *et al.* 2000; Ruigómez *et al.* 2002; Deplanque *et al.* 2004; Pusser *et al.* 2005). The spectrum of risk-factors that were used to indicate risk groups highlights the variations in consensus as to who should be considered for OAC. This also affected the choice of antithrombotic therapies, which over time, has evolved to now exclude APLs.

In this section, I have described the types of studies that were found in this literature review, and I have further described the methods that these papers used to undertake their data collection and analysis. Due to the nature of the various aims of these papers, there was a variety of ways in which samples were obtained. Heterogeneity existed across the studies on numerous factors. For example, sampling varied in terms of how the papers included and excluded patients with AF. Heterogeneity is further evident by the variety of contraindications that emerged and that were used to guide suitability for OAC use.

In conclusion, this section has outlined heterogeneity in the range of methods and reporting used across the papers included in this review. Heterogeneity in reporting OAC by specific factors, produced a complex picture for comparing interpretations of OAC use across the studies retrieved. In the next section, I will report on the OAC rates found within the papers in relation to key clinical practice guideline and service changes.

2.5 OAC used.

There is a common perception in the literature of OAC underuse generally in AF populations. However, this section will describe OAC and antithrombotic use as portrayed by the papers located in general practice. The heterogeneity of factors already specified, represents the current knowledge of key patient, clinician and organisational factors affecting OAC use in general practice. All current factors are presented in order to highlight knowledge gaps about the how general practice affects OAC use. This knowledge gap will then create the rationale for the following chapters.

Studies used common demographic factors such as gender, age, stroke-risk, bleeding-risk factors and social status to describe their OAC use findings. However, there was no single commonly used factor across all the studies retrieved. There was also considerable variability within the factor-measurement points. For example, different age groups were used to portray the OAC use across the studies, thus leading to a complex arrangement of findings.

The details surrounding previous use of antithrombotic therapy and persistence of therapy could only be determined in a few papers. Only two papers (DeWilde *et al.* 2006; Dreishulte *et al.* 2014) reported on a status of OAC use "*ever*", and a further study reported on "*initiation*" and "*maintenance*" phases (Kassianos *et al.* 2013). Finally, another paper determined prior use, and new use, by assessing the OAC use between four dates which identified new OAC users and the persistence of previously started therapy. Therefore, OAC use reported in the other studies may contain patients who might have tried and stopped OAC. The GPs' role in OAC initiation and maintenance was not established in the remaining papers.

2.5.1 Reporting OAC use by age and age group.

OAC uptake by age was commonly described (29/63, 46 %), but the age ranges that were specified for reporting OAC use varied considerably. There was no explanation in any of the papers as to why certain age ranges were chosen to report antithrombotic use. This made direct comparison of OAC use by age, difficult across all the studies included.

Sixteen papers reported OAC use in the 65-74 age group which varied from 17% (Jacobs *et al*. 2009) to 64% (Tomlin *et al*. 2017). This age group is now considered to be an Intermediate stroke-risk alone using the CHA_2DS_2-VASC score, and a group which should be offered OAC. The second most-reported age group for OAC use was people aged over 75 years who were at high-risk of a stroke by all the previous measurements of risk used. Here again, there was OAC use ranging from 29.5% (Boulanger *et al*. 2006) to 65.3% (Brandes *et al*. 2013) with a mean OAC use of 51.6%.

Ages over 80 and 85 years were also commonly cited. Seven papers reported OAC use in what should be considered a very high stroke-risk by any of the previous measures used to measure stroke-risk. The OAC use in patients greater than 80 years old, ranged from just 3.7% (Viscogliosi *et al.* 2017) to 75.6% Hannon *et al*. 2014). The differences in OAC use between the two studies may be due to the rates and types of exclusions and potential contraindications that were applied to their samples (Viscogliosi *et al.* 2017). Many of these were common factors affecting older patients such as reduced mobility, risk of falling and cognitive problems. Similarly, in patients greater than 85 years old, the range of OAC use reported was from 14.7% (Das *et al.* 2015) to 33% (Jacobs *et al.* 2009). The differences stated between these two papers are more difficult to interpret, as Jacobs *et al*. (2009) do not state which contraindications were used, and only included patients taking OAC, whilst Das *et al.* (2015) had very few exclusions. It is possible that these findings may represent a clinician bias towards older patients resulting in the non-treatment with OAC and other papers in the review reported on the likelihood of OAC use in older patients.

Multiple papers in this review also reported on the effect of age on OAC uptake and this was described in different ways depending upon the age categorization and comparisons used in individual papers. For example, in one study, patients less than 80 years old were compared to patients greater than 80 years old for warfarin use between 1990 and 1996, finding that patients less than 80 years old were four times more likely to be using warfarin compared to patients aged greater than 80 years old [OR: 4.0, 95%CI: 1.9 to 8.4, p = not stated] (Smith *et al*. 1999). However, patients who received warfarin were significantly younger (albeit by only one year on average) than those who did not receive warfarin [mean age 73.15±9.74 versus 74.13±13.48, p <0.001] (Mashal *et al*. 2011).

Only three papers reported that age was not a significant factor in OAC uptake (Anderson *et al*. 2005; Robson *et al*. 2014; Apenteng *et al*. 2018). Only one study examined trends in OAC use and found that variations in OAC use were not explained by any demographic factors, including age (Robson *et al*. 2014). The earliest paper to report that age was a significant factor in the uptake of OAC, had conducted a clinical caseload review of patients registered with ten GP practices (Sudlow *et al*. 1997) in accordance with the Stroke Prevention in Atrial Fibrillation trial (SPAF) trial inclusion/exclusion data (Stroke Prevention in Atrial Fibrillation Investigators 1991). This paper found that only 10.3% of patients aged greater than 75 years were treated with warfarin compared to 91% of those aged 65-74. Many of the patients not treated in this study had no contraindications that would have excluded their treatment with warfarin. A further paper stated that NVAF patients aged less than 80 years were over three times more likely to be treated with warfarin (White *et al*. 1999). However, both papers contained data that was guided by the results of RCTs (Stroke Prevention in AF investigators 1991; Laupacis *et al*. 1992) that excluded patients over the ages of 75 which will have influenced how older patients were treated.

Over the period of representative studies included in this review, the rate of age-related OAC varied, but generally, older patients appeared to be less frequently treated with warfarin. However, a study of a single Canadian GP practice found a high proportion of treated patients with NVAF, with 78.2% of the over 60-year olds receiving warfarin (Ceresne *et al*. 2002). Furthermore, 77.1% of patients aged over 80-89 years in this paper, were taking warfarin, with a further 5.7% who had previously been taking warfarin, and with 17.2% having never taken warfarin. Organisationally, although this practice managed 75% of its own OAC, this practice also had twelve full time clinicians and 6 full time nurses, and an externally led, OAC clinic situated on site. No discussion is made as to the transferability of these findings into local Canadian practice and therefore it is even more unlikely, given the resources available in the study, that this model would be replicated in UK general-practice as well. A further paper around this period also reported that OAC treatment was significantly lower in older patients (Blich *et al*. 2004). However, the data presented in that paper suggested the opposite, with the mean age for warfarin treated versus non-treated patients being 77.6 versus 74 years (p <0.001) respectively. A later study examined the use of OAC over a ten-year period using a UK general-practice research database finding that

individually, older patients did receive increasing levels of OAC over time. However, patients over 70 years remained significantly less likely to receive warfarin when compared to younger patients (Scowcroft *et al.* 2012). An adjusted model predicted that patients aged 60-69 years (OR: 2.15, 95% CI; 2.01 to 2.29. *p* <0.001) and 70-79 years (OR: 2.20, 95% CI; 2.08 to 2.33. *p* <0.001) have over twice the odds of receiving warfarin compared to patients aged greater than 80 years. This study was underpinned in its analysis by European Society of Cardiology guidelines that advocated OAC after assessing both CHA_2DS_2VASC and HASBLED-scoring to determine eligibility (Camm *et al*. 2012). Its closing recommendations called for new strategies to improve OAC uptake in this age group. This study was also sponsored by Boehringer Ingelheim Ltd, who around this time, were the market leaders and sole providers of the first direct-acting oral anticoagulant to be licensed, dabigatran (Pradaxa), which it was predicted, would have far reaching impacts world-wide on routine care (Mahan & Fanikos 2011). Furthermore, Boehringer Ingelheim Ltd representatives regularly held events and attended practice meetings during this period to promote the new drug. This suggests that the main sponsor would benefit commercially from the study's findings being implemented in this practice.

However, the most recent study reporting age-related OAC use examined data from a UK stroke registry that included 816 patients with a history of AF prior to first stroke (Jain *et al.* 2017). This study, also reported that increasing age in NVAF patients, considered being at a high stroke-risk, was relating to lower odds of receiving OAC, comparing to patients aged 65 years (Patients ages 75-84 years [OR: 0.37, 95% CI; 0.16 to 0.88, *p* 0.001]; 80+ years [OR: 0.12, 95% CI; 0.05 to 0.33], *p* 0.001). However, the study was only partially able to measure HASBLED scoring using only four criteria, and omitting history of stroke, which may increase the risk of bleeding and thus clinician decisions to omit OAC. Furthermore, the study did not consider factors such as patient refusal, or known contraindications to OAC treatment, which may have affected the overall findings.

The most frequently cited reason for underuse of OAC in older patients by clinicians is the perceived heightened risk of bleeding (Pugh *et al.* 2011). Increasing age has also been long been established as a significant independent bleeding-risk factor and is incorporated into many bleeding-risk assessment tools (Gage *et al.* 2006; Pisters *et al.* 2010; Fang *et al.* 2011;

Hippisley-Cox *et al.* 2014; O'Brien *et al.* 2015). This perhaps reinforces clinicians' knowledge of the increased likelihood of major bleeding in older people. For example, a multidisciplinary survey of USA clinicians consisting of primary care (17%), cardiology and vascular neurologists, were asked what their main considerations were when deciding on both warfarin and DOAC therapy for NVAF patients (Leung *et al*. 2017). The study found that primary care physicians were most concerned about risk of major bleeding (36.2%) and the need for regular blood tests (22.4%), with the increased bleeding-risk in older patients (17%) being their greatest concern. However, in comparison to specialists, significantly fewer GPs were concerned about fluctuations in patient INR readings (39.6% vs 75%/55.5%, *p* 0.028) which may represent GP lack of involvement in, and knowledge about, the direct management of INR readings.

Although there are many examples of papers that demonstrate lower OAC use, these studies do not shed light on decreased OAC use in older patients. Whether GPs are intuitively including this knowledge in decisions about OAC use, or, are using more formalized methods such as bleeding-risk scores, is not clear from this review. One qualitative paper that interviewed seven USA clinicians, including three GPs, also found that the GPs considered older patients to be more at risk of bleeding when using OAC due to the increased likelihood of co-morbidities (Kirley *et al*. 2016). In this paper the GPs were also more inclined to use informal methods of risk assessments than formalised tools when deciding treatments (Kirley *et al*. 2016).

Bleeding-risk.

In this review, only four studies reported on the effect of bleeding-risk scoring and OAC use (Scowcroft *et al.* 2012; Abdul-Rahim *et al.* 2014; Ding *et al.* 2017; Willey *et al.* 2017) and all these papers had applied the scores retrospectively using the collected data without stating whether bleeding-risk was documented separately. However, this data may be not available within the databases used, rather than not used in practice (Aarnio *et al*. 2018). One of the papers also claimed to have used a HASBLED score and defined its parameters (Scowcroft *et al*. 2012). However, all data that was used was retrieved from the GPs' electronic-records via the UK General-practice Research Database (GPRD) and it is unlikely that the Time-In-Therapeutic-Range (TTIR) information would have been included, as it is not something that

is routinely recorded in GP records. As has been previously explained, INR-testing is usually performed externally to the general-practice and calculations of TTIR are not normally automatically communicated from other services. Two of the other studies also mention that it was not possible to calculate a HASBLED score and instead use a modified HASBLED (Abdul-Rahim *et al.* 2014; Ding *et al*. 2017). A third paper above used an alternative score that didn't require INR data (Willey *et al.* 2017). Finally, the papers that included a bleeding-risk score make no reference as to the validity of applying tools that were not designed for NVAF patients and who were not taking VKA therapies, as their samples were now also taking DOAC drugs. For example, the evidence is only now emerging to support of using some of the available tools on patients taking DOAC drugs (Lip *et al*. 2018).

In the earliest paper to report on bleeding-risk scoring and OAC use, the application of the HASBLED score showed that NVAF patients with increasing bleeding-risk scores also had a decreasing likelihood of being prescribed warfarin (Scowcroft *et al*. 2012) (e.g. HASBLED score = 2, OR: 0.85, 95% CI; 0.76 to 0.85; score = 4, OR: 0.43, 95% CI; 0.86 to 3.97, p <0.0001). A further paper found that only when the same HASBLED score results were adjusted to control for lifestyle factors and other co-morbidities, did it become useful in predicting warfarin use, and that was only in high-risk of stroke patients (Ding *et al.* 2017).

Only one paper reported on the application of the HEMORR(2)HAGES score (Gage *et al.* 2006) finding that untreated patients had significantly higher bleeding-risk scores (HEMORR2HAGES: ≥4 = 70%) compared to those treated with OAC (HEMORR2HAGES: ≥4 = 26.70%, p <0.001) (Willey, *et al.* 2017). A final paper in this review failed to find any significant associations between bleeding-risk scores and the levels of OAC use (Abdul-Rahim *et al.* 2014). This point is also supported by a study of German centenarians where it was established that only 26.7% of patients received anticoagulants despite having lower HASBLED scores compared to younger patients (Kreutz *et al*. 2018). It is therefore essential that individualised approaches to AF management in older patients are developed (Alagiakrishnan *et al*. 2018) and it may be that more individualised bleeding-risk tools may be more useful in predicting risk/events and more convenient in encouraging OAC use in practice than intuitive decision-making (Emmanouilidou *et al*. 2018). To summarise, none of the papers in this review published findings on GP-reported use of bleeding-risk scoring.

Instead all papers used the retrospective application of such tools by the researchers. However, a lack of demonstrable evidence of the routine clinical use of bleeding-risk scoring in this review doesn't mean that they are not being used or are not useful in practice. However, of the papers that did report findings, the scores also portrayed mixed findings in predicting the likelihood of OAC use. This raises two questions here, namely, how are bleeding-risk scoring being applied, if at all, into routine general-practice OAC care? Furthermore, what effects are the use of bleeding-risk tools having, if at all, on the OAC levels prescribed?

2.5.2 Anti Platelet (APL) use in older people.

A factor that is present in all the available bleeding-risk tools and was widely reported in the papers found in this review is the use of APL drugs. APL use was also reported by a variety of age groups in eight papers (Table 10). The most cited age range for APL use was the age category "*65-74*" with reported APL use of 13% (Jacobs *et al*. 2009) to 49.2% (Simpson *et al*. 2005). The age group category "*over 75 years*" was used by three papers which reported APL usages of 20.4% (Brandes *et al.* 2013), 52.9% (Murphy *et al.* 2007) and 58.4% (Simpson *et al.* 2005). Patients over the age of 75 years were consistently found to have increased rates of APL use than those younger than 75 years, although this had dropped in the most recent three studies (Table 10), most likely reflecting the changes in the prevailing guidelines which now refuted the effectiveness of APL use in AF.

Table 10. APL used as stated by differing age categories.

	Author, (year), Number (%) of patients treated with APL.								
Ages reported.	Oswald (1999).	Simpson (2005).	FALSTAF study group (2007).	Boulanger (2006).	Jacobs (2009).	Murphy (2007).	Apenteng (2017).	Brandes (2013).	Hannon (2014).
45.	-	-	-	-	-	6 (14.3)	-	-	-
40-54.	-	-	-	(18.7)	-	-	-	-	-
45-54.	-	-	-		-	32 (25.4)	-	-	-
55-64.	-	-	-	(21.2)	-	114 (37.4)	-	-	-
<60.	-	-	49 (12.3)	-	-	-	-	-	-
60-70.	-	-	111 (12.0)	-	-	-	-	-	-
60-74.	21(33)	-	-	-	-	-	-	-	-
65-74.	-	135 (49.27)	-	(36.6)	2(13)	209 (38.8)	217 (29.9)	-	-
70-80.	-	-	300 (13.0)	-	-	-	-	-	-
<75.	-	-	-	-	-	-	-	134 (16.7)	-
75.			-	-	-	361 (35.7)	-	-	-
75+.		440 (58.43)	-	-	-	354 (52.9)	417 (57.5)	192 (20.4)	-
75-84.	41(39)	-	-	-	6(38)	275 (51.7)	-	-	-
<80.	-	-	-	-	-	-	-	-	100 (16.00)
80+.	-	-	651 (28.9)	-	-	-	-	-	87 (19.5)
85.	-	-	-	-	-	79 (57.7)	-	-	-
85–115.	36(54)	-	-	-	-	-	-	-	50(8)
$ Colour bands represent key changes in OAC guidelines (see Figure 2. P9.)									

A further possible barrier for an older patient using OAC is that, previously, there has also been an over reliance in the use of APL drugs. Six papers discussed the association between OAC uptake and APL use in older patients over time. The earliest paper involved a review of a French general-practice database which included over 3000 NVAF ambulatory patients, with a mean age of 75 years (FALSTAF *et al.* 2007). This paper found that 75% of patients were taking warfarin although; the use of warfarin fell sharply with age. Those aged over 70 years decreasing by an average of 9.6% per year (OR: 0.90, 95%CI; 0.89 to 0.92, p <0.05) but conversely, the use of aspirin increased in those older than 70 years by 9.6% per year. Two separate guidelines are referred to in this paper (Albers *et al*. 2001; Fuster *et al*. 2001) and both encourage the use of warfarin in patients aged over 75 years as first-line therapy. However, a caveat also suggests that clinicians should consider the ability to provide close INR monitoring, individual bleeding-risk, and include patient preferences, when deciding if VKA or APL is used; explaining the high use of aspirin in this group.

Similarly, two other papers retrieved, demonstrated that age was a significant factor in decreased OAC use, and increased APL use (Ruigómez *et al.* 2002; Gallagher *et al.* 2008). Both papers used the UK GPRD to obtain their data. The first study examined over 1000 NVAF patients with a nested case-study design, and found that patients aged 80 years and older, were 80% less likely to be treated with warfarin than younger patients (Ruigómez *et al*. 2002). This same study, also found, that patients older than 80 years and those aged 70-79 years, were relatively also more likely than younger patients, to use APL instead of warfarin (OR: 2.9, 95%CI; 1.5 to 5.5; OR: 3.0, 95%CI; 1.6 to 5.6, *p* not stated) respectively. The second study here assessed the first prescription of antithrombotics used after NVAF diagnosis comparing patients by age groups (Gallagher *et al.* 2008) finding that those aged over 70 years (OR: 0.72, 95% CI; 0.66-0.78, *p* not stated), and those aged over 80 years (OR: 0.39, 95% CI; 0.36-0.43, *p* not stated), were less likely to be treated with warfarin, and far more likely to be using APL (Gallagher *et al.* 2008). Although in the first example, there is no reference as to the guidelines that were operational during the data collection, in the second paper (Gallagher *et al*. 2008), the prevailing guideline referred to age equal to, or greater than 75 years, as only being a moderate risk-factor, which on its own, should be treated with either aspirin or warfarin. Given a clinical option, and in view of the difficulties and concerns around INR-testing, it is conceivable that aspirin therapy could have been perceived to have been an easier clinical option for use, especially in patients without other high-risk factors. But this is speculative and requires further investigation.

Age, therefore, does seem to be a highly relevant factor that may act as a barrier to OAC use, but not all older patients were declined OAC treatments. Another study involving a much older cohort (mean age 87.1 ± 5.3) of 1085 French NVAF patients living in 104 residential homes (Bahri *et al*. 2015), finding that only 50% of patients were taking warfarin whilst, 75% took aspirin and 9.2% took nothing. In Bahri *et al*. (2015) a significant difference existed in the mean ages of those taking warfarin (85.8 ± SD 4.9) compared to the mean ages of those not taking warfarin (88.3 ± SD 5.2, *p* 0.01). Furthermore, this also resulted in significantly increased odds for patients to be not (OR: 1.1, 95% CI; 1.01 to 1.17, *p* 0.02). However, this may be explained by the possible status of immobile, frail patients that this cohort would comprise.

Recent studies have also concluded with mixed responses to the question of the effect of age on OAC use. This may reflect the changes in the types of OAC used as clinical practice moves away from warfarin. However, there is also mixed evidence in relation to this notion. For example, a study involving a large USA primary-care based research network, between 2010 and 2015, explored the patterns of OAC use since the introduction of DOAC drugs, finding that there was a significant increase use of DOACs at the expense of warfarin, but no overall increase in the levels of OAC used (p <0.001 for trend) (Ashburner *et al.* 2017). A further finding of interest, was that those using DOACs, were on average, significantly younger than those patients taking warfarin (mean age 72.9 versus 76.9, p <0.001). However, another study of a large UK population-based survey of newly diagnosed NVAF patients, found that age was not significantly related to either the overall OAC or DOAC use (Apenteng *et al.* 2018). However, other factors may also be acting in synergy with age such as comorbidities, e.g. dementia; strengthening the observations that age is a significant barrier to OAC used in general-practice.

Age & Dementia.

Dementia, AF rates and stroke-risk all increase with age indicating that many patients with both conditions will be at increased risk of stroke. However, this review has found conflicting evidence concerning dementia patients' treatment with OAC. For example, Jacobs *et al*. (2009) found no significant difference in the treatment rates of dementia sufferers, and Bahri *et al.* (2015), whilst claiming that dementia was the second most common reason for underuse (22%), did not find a statistically significant effect of dementia on the use of OAC. However, two papers that both used the UK GPRD (Gallagher *et al*. 2008; Scowcroft *et al*. 2012), and a third later paper that reported on over 300 Scottish general-practices (Dreishulte *et al.* 2013), also found that a dementia diagnosis was associated with a reduced likelihood of OAC use. A more recent cross-sectional study of community dwelling older people over the age of 65 years, who were selected with an absence of falls, anaemia, inability to walk or being in a wheelchair, who also had no severe neuropsychiatric symptoms, also examined the impact of dementia on OAC use (Viscogliosi *et al*. 2017). Ninety-six percent of those included, were estimated to be at moderate or high stroke-risk, and thus eligible for OAC. However, 38% were untreated with OAC and both

patients with dementia and older patients (aged >80 years) with dementia, were increasingly less likely to receive OAC. The exclusions used in this study, could well apply to many patients with known dementia on general-practice caseloads. Therefore, the effect of dementia on OAC use in normal daily general-practice may arguably, be even higher than was reported here. Only one paper, a prospective study of UK NVAF patients which consisted of data from a UK registry of 3482 newly diagnosed patients managed by 186 GPs, reported a non-significant finding that patients with dementia were positively associated with OAC use (Apenteng *et al*. 2018). However, the study also found that dementia patients also had over three and a half times higher odds of being treated with a DOAC over warfarin (OR: 3.58, 95% CI; 1.15 to 11.15, *p* not stated). This suggests that the introduction of DOAC drugs may be positively impacting on the GPs' willingness to treat dementia patients with OAC. The previous negative perceptions towards dementia and OAC use may now be changing, but other commonly cited factors were also associated with OAC use and non-use, with the next most common factor being gender.

2.5.3 Reporting OAC use by Gender.

OAC use was described by gender in only 18/63 (28.5%) of papers (Table 11) and these papers all showed, that OAC was used more commonly in men than women, except for one study based in a nursing home, whereby it was found that although not statistically significant, relatively more women than men were treated with OAC (Bahri *et al*. 2015). Of the papers that stated OAC use by gender, only one paper further examined this across different age groups (Scowcroft *et al.* 2012). Here, OAC use was measured in females and males in the following age groups, 60–69 years, 70–79 years and 80+ years. The resultant OAC use was persistently higher in males than females showing a female to male OAC use of 3268 (52%)/6380 (59%) in 60–69 years, 7433 (52%)/9208 (57%) in 70–79 years and 6246 (29%); 584 (36%) 80+ years old.

Two further papers also examined OAC use over time (Apenteng *et al.* 2017; Lacoin *et al.* 2017). One paper also examined the OAC uptake in males, over a period over time between 2012 and 2016, finding numbers of male patients treated as 35277 (52.4%) to 24 495 (54.3%) (Lacoin *et al.* 2017). The second paper examined female use in 2011 to 2013 and

compared this to 2015 to 2016, finding only four female patients taking DOACs initially, rising to two hundred and ninety-one in 2015- 2016 (Apenteng *et al.* 2017).

Table 11. OAC used as reported by gender.

Author.	Year.	Female.	Male.	Odd ratio for OAC treatment (CI-95%) Female.	Odd ratio for OAC treatment (CI-95%) Male.	*p.*
Ruigómez.	2002	98 (17.9)	102 (20.9)	0.9 (0.7-1.2)	Reference	ns
Simpson.	2005	265 (46.7)	321 (58.1)	-	-	-
White.	1999	-	42 (42)	Reference	1.7 (0.9–3.4)	ns
Carlsson b (2007).	2013	1036 (46.4)	1437 (53.3)	-	-	-
Lee.	2011	461 (22.2)	415 (29.4)	-	-	-
Mazzaglia.	2010	802 (28.2)	939 (35.5)	0.71 (0.65-0.78)	Reference	-
Dreishulte.	2014	-	-	0.76 (0.72-0.81)	Reference	-
Johansson.	2014	473 (43.5)	-	-	-	-
Willey.	2018	7468 (40.3)	11081 (59.7)	-	-	-
AbuDagga.	2014	Dabigatran: 878 (29.1) Warfarin: 6,775 (39.2) *p* <.000	Reference	Pre-index: 0.87 (0.79-0.96) OAC naive: 1.02 (0.83-1.26)	Reference	Pre-index: 0.0035 OAC naïve: 0.8362
Sabouret.	2015	-	7176 (61.3)	0.65 (0.60-0.70)	Reference	< 0.0001
Viscogliosi.	2017	(63.0)	-	1.06 (0.96-1.17)	Reference	0.247
Adderley.	2018		Yr. 2000 (51.8) Yr. 2015 (57.5)	-	-	-
Apenteng.	2017	VKA =565 (44.6) NOAC = 262 (44.6)	-	Reference	0.90 (0.72-1.12) for NOAC	-
Bahri.	2015	392 (72.5)	149 (27.5)	-	-	0.50
Lacoin.	2017	-	14 580 (43.6)	Reference	0.87 (0.81-0.93)	<0.0001
Jain.	2017	$CHADS_2$ >2 = 131 (47.5%) CHA_2DS_2VASC > 2 = 347 (64.3%)	$CHADS_2$> 2= 145 (52.5%) CHA_2DS_2VASC > 2 = 193 (35.7%) 0.005	Reference	0.71 (0.40–1.25) (For NOTHING of OAC compared to females)	0.234
Mazurek.	2017	520 (45.3) Guideline adherent.	-	-	-	0.74
Tomlin.	2017	2941 (58.0) (93.1 high-risk)	3357 (62.9) (73.5% high-risk)	0.83 (0.77-0.90)	Reference	<0.001

$ Colour bands represent key changes in OAC guidelines (see Figure 2. P.9)

The relationship between gender and OAC was reported in 26 papers included in this review. However, only two studies found that gender was not predictive of the likelihood of OAC use in NVAF patients (Mashal *et al.* 2001; Ruigómez *et al.* 2002).

The earliest study to report negative gender differences in OAC use, examined patients with a history of stroke linked to 61 general-practices, finding that women were significantly less likely to receive warfarin compared to men. Furthermore, females were also more likely than males to receive aspirin (Simpson *et al.* 2005). However, this paper didn't adjust for confounding factors such as potential contraindications, which may have affected the odds of the OAC used. Further studies, incorporating large general-practice databases, both in the USA (Boulanger *et al.* 2006) and UK (DeWilde *et al.* 2006), and a large primary care cohort of NVAF patients in Sweden (Johansson *et al.* 2014), also found that men were more likely to be treated with warfarin than woman.

The risk of stroke experienced by women was also found to be non-predictive of OAC use when compared to men. A study assessing pre and post stroke, in patients with NVAF, found that pre-stroke, only 22% of women vs 29% of men were prescribed OAC. There was a post-stroke increase in both males and females, although there was also a significant difference across genders (35% of women vs 48% of men, p <0.001), which occurred despite women typically having a higher $CHADS_2$ risk-score (Lee *et al.* 2011). Similarly, a large French primary care study, found that although women were found to have an increased risk of stroke as per CHA_2DS_2VASC and $CHADS_2$ risk-score, women were also more likely to not receive warfarin, and this varied little depending on the stroke stratification tool used (Sabouret *et al.* 2015).

Only one paper, suggested that women with a history of stroke, were more likely than males to be using warfarin (White *et al.* 1999). However, this was a non-significant finding. The emergence of DOAC drugs appears to also have had little effect on the overall use of OAC in female NVAF patients. A large USA general-practice insurance-claims database, which included over 20,000 NVAF patients, found that females were at significantly lower odds of receiving Dabigatran compared to warfarin, and compared to males (AbuDagga *et al.* 2014). However, the results were found to be not significant in OAC naïve patients, suggesting that there could be progress in treating females. Older females are at risk of undertreatment

with OAC. A large Swedish population study found that both men and women had reduced likelihood of treatment with warfarin, but women aged 85 years (OR: 0.20, 95%CI; 0.80-0.46, *p* <0.001) and over, also had significantly lower odds for using warfarin, compared to males aged 85 years old (OR: 0.50, 95%CI: 0.31-0.80, *p* <0.001) (Carlsson *et al.* 2012). The more recent studies found in this review, did not confirm any increased likelihood of OAC use in women. To the contrary, women were still found to be less likely than men to receive OAC treatment versus aspirin, and men were less likely than women to receive nothing or OAC (Lacoin *et al.* 2017). However, a final study that examined the period after the introduction of DOAC drugs (2010 to 2014) and included data from 170 New Zealand general-practices of 12,712 NVAF patients, showed that although 58% of females were now treated with OAC, females were still also less likely to be treated when compared to males (Tomlin *et al.* 2017). However, the odds of female OAC use have improved, and this may be due to increasing GP awareness of the increased stroke-risk that women have, as included in the CHA_2DS_2VASC risk-scoring tool, now recommended for use in general-practice.

The reasons why females do not receive the same OAC treatment as males are unclear, and there is a lack of research investigating this question. However, it has been suggested that GPs may have specific negative health beliefs towards females that create clinician led barriers towards treatment (Loikas *et al.* 2015). It can be generalised from this literature review that older women have faced barriers to OAC use in general-practice. Both, age and gender are now concurrent risk-factors included within the stroke-risk assessment tools widely adopted for GP use. Therefore, clinicians must now be considering old age and gender if they are using such stroke-risk tools routinely. However, the relationship between stroke-risk factors and assessment tools to OAC treatment outcomes in general-practice is uncertain, which this review will now discuss.

2.5.4 OAC use described by stroke-risk factors.

Individual stroke-risk factors and OAC use were reported upon in several papers (Table 12), with only seven of this set of papers reporting on the OAC uptake of patients who had had a prior stroke. Further variance of OAC uptake existed, with evidence to suggest that this high-risk group of patients were also generally undertreated with OAC. The most recent paper also highlighted that patients who had experienced a prior stroke, accounted for 13%

of the overall underuse rates of 36% (Mazurek *et al*. 2017). Two further papers also reported OAC use against individual stroke-risk factors, but additionally, also categorized OAC use by reporting on differing age groups (Scowcroft *et al.* 2012; Hannon *et al.* 2014). Both papers reported that there was a decreasing OAC uptake across the stroke-risk factors used with increasing age of the patients. This reinforces the claim about the negative effects of age on OAC use and introduces the notion that GP rationale for OAC prescribing is being superseded by other factors, if they are considering stroke-risk when making decisions about OAC use.

Table 12. Independent stroke-risk factors and OAC use.

Author.	Year.	Congestive heart failure.	Ischemic heart disease.	Hypertension.	Diabetes mellitus.	Previous stroke or TIA or arterial embolism.	Vascular disease.	One or more risk factors for embolism.
		Number (%) of patients treated with OAC.						
White.	1999	16 (47)	14 (43)	50 (37)	9 (33)	10 (45)	17(41)	-
Boulanger.*	2006	(17.3)	-	(43.8)	(24.3)	(10.4)	-	-
Deplanque.	2004	16 (19.5)	26 (31.7)	-	19 (23.1)	-	-	-
Ewen.	2012	(12.4)	(20.4)	(43.1)	(15.6)	(11.1)	-	-
Mashal.	2011	-	125 (63.8)	437 (62.5)	157 (66.5)	-	-	-
Mazzaglia.	2010	150 (39.1)	-	813 (33.6)	-	-	88 (51.2)	-
Johansson.	2014	305 (28.1)	-	812 (74.7)	200 (18.4)	301 (27.7)	238 (21.9)	1063 (97.8)
Apenteng.*	2017	97 (7.7)	168 (13.3)	961 (79.2)	249 (19.7)	78 (6.2)	125 (9.9)	-
Apenteng.**	2017	36 (6.1)	90 (15.3)	451 (80.0)	94 (16.0)	46 (7.8)	64 (10.9)	-
Mazurek.¥	2017	148 (18.1)	53 (6.5)	494 (60.5)	150 (18.4)	241 (21.0)	156 (19.1)	-

*VKA only ** NOAC ¥guideline adherent $ colour bands represent key changes in OAC guidelines (see Figure 2. P9.)

2.5.5 Reporting OAC use by stroke-risk and stroke-risk scoring.

Using risk scoring tools may offer a more pragmatic way for GPs to include individual stroke-risk-factors in OAC decisions, so papers that reported OAC use this way were analysed. Estimated stroke-risk classifications were also used to portray OAC used differently across the papers retrieved, dependent upon the descriptions set within the prevailing guidelines of the studies. For example, five papers used terms "*low, intermediate and high-risk groups*" (Table 13) indicating high-risk OAC use variance. However, again, discrepancies existed in the risk descriptions used, despite the majority using the established $CHADS_2$ risk-score. Intermediate-risk included, $CHADS_2$ risk-score between 2 to 4, and high-risk included a score

of 5 or 6. However, Boulanger *et al*. (2006), described intermediate-risk categories as patients with a $CHADS_2$ risk-score of 2-3, as being of intermediate-risk, and high-risk as scoring greater than 4. Therefore, cautious interpretation is needed comparing the treatment within published "*risk-groups*" across the studies using them.

Table 13. Levels of "*stroke-risk*" and OAC use.

Author.	Year.	Low-risk.	Moderate Risk.	High-risk.	Very high-risk.
		Number (%) of patients treated with OAC.			
Sudlow. *	1998	-	-	(23)	-
DeWilde.	2006	340 (33.0)	1258 (36.9)	2397 (40.9)	861 (43.8)
Pusser.	2005	-	-	(94)	-
Boulanger.	2006	-	(36.1)	(7.1)	-
Mazurek.¥	2017	86 (7.5)	49 (4.3)	1012 (88.2)	-

¥ Guideline adherent. $ Colour bands represent key changes in OAC guidelines (see Figure 2. P9.). * Percent only reported.

The most recent study recorded a high guideline adherence, in those most at-risk of stroke (Mazurek *et al*. 2017). However, this same group of NVAF patients also accounted for 87.5% off the total underuse recorded in the study, suggesting that the clinicians may not be using the information on stroke-risk specifically to make OAC decisions. This required clarification from papers that published OAC use by actual stroke-risk scores. For example, OAC use, reported by both $CHADS_2$ and CHA_2DS_2VASC risk-score, were used by twenty-two papers, but with variations in the ways that the results were presented (Table 14). One study, which classified stroke-risk based on the $CHADS_2$ risk-score differently, found that OAC treatment in low-risk was 72.2%, but these patients included those who might be considered intermediate-risk in other papers (Jacobs *et al*. 2009). The levels of OAC use in those at "*low-risk*" may be explained by studies that have examined other factors such as specific cardiac conditions and specialised drugs. Patients with such factors may have been and still be more inclined to be treated with OAC by specialists (DeWilde *et al*. 2006). Particularly, as they pass through specific cardiology treatment programmes such as, DCCV or cardiac ablation therapy which may not require permanent OAC treatment.

Table 14. OAC used described by $CHADS_2$ and CHA_2DS_2VASC scores.

Author.	Year.	Variations of $CHADS_2$ described (where stated).	Low-risk ($CHADS_2$ = 0).	Intermediate-risk ($CHADS_2$ = 1).	High-risk ($CHADS_2$ = >2).
			Number (%) of patients treated with OAC.		
Boulanger.*¥	2006		(56.9)	-	-
Dinh. ¥	2007		(54)	(70)	-
Ewen.	2012		-	-	(38.2)
Jacobs.	2009	Low-risk 0-1. Intermediate 2-4. High 5-6.	13 (72.2)	70 (87.5)	7(100)
Khan.	2014		-	-	63 (60)
Mashal.	2011		69 (52.7)	391 (60.3)	131 (60.6)
Mazzaglia. ¥	2010	$CHADS_2$ 0-4+.	(20.8)	(31.7)	-
Brandes.	2013		19 (27.5)	331 (67.8)	719 (69.3)
Cowan.	2012	$CHADS_2$ scores 1-6.	-	-	-
Dreishulte. ¥	2014		(38.5)	(57.4)	(44.9)
Holt. ¥	2012	& CHA_2DS_2VASC.	(32.1)	(46.0)	(53.0)
Kassianos.	2013	Initiation and maintenance phases.	15 (28.8) 37 (35.9)	34 (33.7) 126 (55.8)	62 (39.5) 242 (55.0)
Meinertz. ¥	2011		(58.5)	(68.8)	(71.3)
Adderley.	2018	Trends 2000-2016.			
Clua-Espuny.	2013		-	-	195(76.5)
Ding. ¥	2017	Trends 2000-2010.	(0) (20.0)	(17.0) (35.1)	(25.4) (47.7)
Forslund. ¥	2013		(26.70)	-	-
Hannon.	2014	Mean <80, >80 age.	-	-	-
Sabouret.	2015		1751 (15.0)	3684 (31.5)	6264 (53.5)
Scowcroft.	2012	By risk and age groups.	-	-	-
Valentinis. ¥	2014		-	(68.10)	-
Shantasila.	2015	& CHA_2DS_2VASC.	80 (25)	214 (40)	891 (46)

*warfarin only. $ Colour bands represent key changes in OAC guidelines (see Figure 2. P9.). ¥ Only percentage data available.

Intermediate stroke-risk, defined as $CHADS_2$ risk-score = 1, was reported in eight papers in relation to OAC use which ranged from 31.7% (Mazzaglia *et al.* 2010) to 70% (Dinh *et al.* 2007). A further eight papers reported high stroke-risk in relation to OAC use as defined by patients with a $CHADS_2$ risk-score greater than 2. Finally, OAC use in patients with a high stroke-risk ranged from 38.2% (Ewan *et al.* 2012) to 76.5 % (Clua-Espuny *et al.* 2013). Of the papers that have reported $CHADS_2$ risk-scoring by risk-category (n=4), an additional paper (Cowan *et al.* 2012) also reported $CHADS_2$ and OAC use by individual $CHADS_2$ risk-scores (0-6) (Table 15).

Table 15. OAC use described as individual $CHADS_2$ scores.

Author.	Year.	$CHADS_2$ = 0.	$CHADS_2$ = 1.	$CHADS_2$ = 2.	$CHADS_2$ = 3.	$CHADS_2$ = 4.	$CHADS_2$ = 5.	$CHADS_2$ = 6.	$CHADS_2$ = 4-6.
		Number (%) of patients treated with OAC.							
Dinh. ¥	2007	(54)	(70)	(90)	(80)	-	-	-	(70)
Mazzaglia. ¥	2010	(20.8)	(31.7)	(35.9)	(39.4)	-	-	-	(39.3)
Cowan.	2012	12857 (34.04)	29144 (47.03)	35431 (52.50)	20105 (57.56)	12076 (56.22)	3952 (55.79)	647 (58.13)	-
Holt. ¥	2012	(32)	(46)	(50.8)	(56.1)	(54.5)	(54.1)	(52.6)	-
Clua-Espuny.	2013	19 (7.0)	59 (21.7)	84 (31.0)	61 (22.5)	61 (22.5)	33 (12.2)	11 (4.1)	4 (1.5)
Forslund.	2013	-	-	-	(54.30)	(53.0)	(47.90)	(50.70)	-
Shantasila.	2015	80 (25)	214 (40)	311 (46)	182 (50)	131 (55)	46 (47)	7 (44)	-

$ Colour bands represent key changes in OAC guidelines (see Figure 2. P.9). ¥ Only percentage data available.

Two studies using $CHADS_2$ risk-scores also reported OAC use below 40% in those at high-risk of stroke (Dreishulte *et al*. 2014; Ewan *et al*. 2012). The first study involved a USA general-practice cohort of NVAF patients and reported a 25% discontinuation rate of OAC in the first twelve months. The low OAC rates described may have been affected by the nature of the healthcare system, as patients may have been receiving treatment from a specialist. Prescriptions for OAC by non-generalists were not captured and therefore may have led to the possibility of flawed published OAC rates. It is also suggested that some healthcare providers, both hospitals and insurance organisations, may set preferences for specific drugs in OAC use (Robson *et al* 2014). Similarly, the second paper to report OAC rates under 50% in those at high-risk of stroke (Ewan *et al*. 2012) also found that 60.8% of the sample had at some time used OAC.

This finding suggests a 25% discontinuation rate. However, the reasons why OAC-naive patients decline the offer of OAC therapy may be different from the reasons why patients later discontinue them. For example, personal drug costs, travelling for testing or the need for operations and procedures. Furthermore, no studies in this review undertook a comparative analysis asking this question. Thus, there is a need for further research to understand if there are any differences between OAC naïve and non-naïve patients' reasons for declining OAC, to inform future treatment strategies.

The CHA_2DS_2VASC risk-score was also used to report the use of OAC in eight papers. In five of these papers OAC was reported in terms of low, intermediate and high-risk groups (Table 16). However, there was incomplete data for all risk-groups across most papers.

Table 16. OAC use by CHA_2DS_2VASC risk category.

Author.	Year.	Low-risk. (CHA_2DS_2VASC = 0).	Intermediate-risk. (CHA_2DS_2VASC = 1).	High-risk. (CHA_2DS_2VASC = >2).
		Number (%) of patients treated with OAC.		
Brandes.	2013	-	91 (58.0)	1045 (68.9)
Meinertz. ¥	2011	(40.5)	(66.3)	(70.8)
Ding. ¥	2017	2001-2004 (0.0) 2007-2010 (0.0)	2001-2004 (0.0) 2007-2010 (0.0)	2001-2004 (23.6) 2007-2010 (46.2)
Robson.	2014	-	1943 (50.8) * 2085 (52.6) **	-
Dreishulte. ¥	2014	(28.60)	(38.20)	(39.20)
Mazurek.	2017	0	101 (12.4) p <0.001	715 (87.6) p = 0.68
Shantasila.	2015	40 (24)	-	931 (45)
Willey.	2017	1061 (5.70)	2220 (12.0)	15 268 (82.3)

* The proportion of people with CHA_2DS_2VASC ≥1 on an anticoagulant pre-intervention (2008) ** the proportion of people with CHA_2DS_2VASC ≥1 on an anticoagulant pre-intervention 2011. $ Colour bands represent key changes in OAC guidelines (see Figure 2. P.9). ¥ Only percentage data available.

OAC use ranged from 39.2% (Dreishulte *et al.* 2014) to 68.9% (Brandes *et al.* 2013) for those assessed to have been at high-risk using CHA_2DS_2VASC risk-scoring. The CHA_2DS_2VASC risk-score has the main advantage of identifying those NVAF patients at truly low-risk, who therefore should not receive OAC treatment. Although, some papers reported overuse in this group of patients, there was a reported reduction in OAC overuse in more recent studies with just 5.7% OAC use in the most recent paper (Willey *et al*. 2017). The specific reasons for overuse are not explored as previously stated. However, on reflection, it may be that patients with true low stroke-risk as indicated by CHA_2DS_2VASC risk-score of 0, were not identified. Furthermore, patients with AF also have other indications for OAC such as cardiology interventions for NVAF (Kowey *et al*. 2010; Taillandier *et al*. 2012). Other indications, or reasons for OAC in patients with a low stroke-risk and the evidence for these factors, were not routinely captured in the data collected.

Six other papers also reported OAC use by individual CHA_2DS_2VASC risk-scores (Clua-Espuny *et al*. 2013; Holt *et al*. 2014; Sabouret *et al*. 2015; Shantasila *et al*. 2015; Lacoin *et al*. 2017;

Tomlin *et al*. 2017). There was a generalised undertreatment across all CHA_2DS_2VASC risk-scores greater than 2, suggesting that CHA_2DS_2VASC risk-scoring is also not promoting OAC use in general-practice. These rates of use may have been affected by the interpretation of contraindications within individual studies (Appendix 9, P.359). For example, one paper considered age greater than 75 years and stroke to be potential reasons not to anticoagulate (Clua-Espuny *et al*, 2013). To summarise, only one study reported that OAC use may be associated with stroke-risk scoring, indicating that warfarin uptake significantly increased across all $CHADS_2$ risk-scores (Jacobs *et al*. 2009). However, another paper only found this effect when adjusting for age groups and general-practices (Scowcroft *et al*. 2012). Other papers either claimed only weak, or no associations between stroke-risk and OAC use (Mazzaglia *et al*. 2010; Lee *et al*. 2011; Mashal *et al*. 2011; Dreischulte *et al*. 2013). Whilst, one further paper was only able to demonstrate that APL and not OAC use, significantly increased with stroke-risk profiling scores (Mazzaglia *et al*. 2010). Lastly, a small qualitative study also found that GPs more often used informal assessments of risk rather than using formal tools when deciding OAC treatment (Kirley *et al*. 2016). However, patients who were not treated with OAC were also treated preferentially with APL. Therefore, APL in this situation, may itself, be perceived to be a barrier to OAC.

2.5.6 Stroke-risk described by either stroke-risk score, over time.

The literature search revealed only five papers that examined antithrombotic use over time (Ashburner *et al*. 2017; Ding *et al*. 2017; Adderley *et al*. 2018; Apenteng *et al*. 2018; Jain *et al*. 2018). A summary of these findings is presented in Appendix 11 (P.362). OAC use for high-risk patients increased significantly between 1995 to 2014, from 9.3% to 30.4% (Jain *et al*. 2018). Similarly, a further study also found that increased OAC rates corresponded to a reduction in APL use in high-risk patients (Adderley *et al.* 2018). In this paper, high stroke-risk was defined as a CHA_2DS_2VASC greater than 2, and APL use in this patient group decreased significantly from rates of 35% use in 2000, to 12.3% (trend decrease $p < 0.0001$) in 2015 (Adderley *et al.* 2018).

The trend of increase in OAC use and decrease in APL use was also confirmed in high-risk patients comparing OAC use in 2001 and 2004, to 2007 to 2010 (Ding, *et al*. 2017). This paper found a significantly increased OAC uptake, from 23.0% to 33.1% (p 0.008) (Ding, *et*

al. 2017). However, in both the above studies, less than half of all high-risk patients were treated with OAC.

A further study examined the average CHA_2DS_2VASC risk-score and OAC uptake over the period from 2010 and 2015 (Ashburner *et al*. 2017). Both, the average CHA_2DS_2VASC risk-score and OAC rates increased over time, starting from a mean score of 3.72 (47.5% OAC use) in 2010, to 4.19 (55.9% OAC use) in 2015. Overall, Ashburner *et al*. (2017) found that those with the highest risk (CHA_2DS_2VASC >4) had an increased rate of OAC use over time, starting at 53.1% in 2010, to 63.8% in 2015. A final study included here estimated that although 86.9% of its study population had a CHA_2DS_2VASC ≥2, only 35.4% of these were treated in 2001. (Adderley *et al*. 2018). In this study, both the amounts of stroke-risk (90.3%) and the rates of those at risk being treated with OAC, significantly increased (71.5%) in 2016 (Adderley *et al*. 2018). These OAC use increases may have relative to the prevailing national guidelines. Specifically, since 2006 In UK general-practice, OAC eligibility has been defined by $CHADS_2$ risk-score greater than 1, in patients with no contraindications (NICE 2006). However, this was later superseded by CHA_2DS_2VASC scoring tool (Camm *et al.* 2012) which better estimated patients at true low risk, but also increased the number of eligible patients for OAC use. It is perhaps the legacy of the latter guideline which is portrayed in these later studies of Ashburner *et al*. (2017) and Adderley *et al*. (2018).

However, changing OAC eligibility based on changing stroke-risk stratification schemata would affect studies retrieved in this review whose dataset were relative to this time. As such, researchers also had to choose to report OAC use after applying both schemata and this was often done retrospectively and not in clinical real time. The effect of applying different stroke-risk schemes retrospectively, however, skews the conventional real-world GP-treatment patterns. This was again exemplified by a study employing data from 2010, involving the use of OAC pertaining to over 21,000 patients from 316 Scottish general-practices (Dreishulte *et al.* 2017). The study found that 53.8% and 30.3%, stratified by $CHADS_2$ risk-score as being at high and intermediate-risk respectively, were then considered to be high and intermediate-risk in 85% and 9.7% respectively, when applying CHA_2DS_2VASC risk-score. Altering the boundaries for stroke-risk naturally resulted in different levels of reported uptake in OAC use depending upon the stroke-risk scheme used. Thus, when

Dreishulte *et al.* (2017) applied the CHA_2DS_2VASC risk-score, redefining patients at high-risk, they estimated that only 45% of patients were taking OAC. However, again, the findings did not consider possible contraindications (CIS). Caution is therefore required when drawing conclusions about OAC use in papers that have retrospectively applied stroke-risk assessment criteria as it is possible that the clinicians at that time were either unaware risk scoring of or simply not using it formerly.

However, it does seem that the trends for OAC use are slowly increasing, albeit at different rates and at higher stroke-risk. This is mainly due to the reduction in the levels of APL prescribed (Adderley *et al.* 2018) rather than increasing the levels of OAC undertreatment that have always existed. Other factors must be also acting to negatively affect clinician choices for OAC use. These may include clinician assumptions and beliefs about patient bleeding-risk factors such as, a history of, or a perceived likeliness of falling.

2.5.7 OAC use in patients with falls.

Thirteen papers listed "*falling*" as a contraindication to OAC (Appendix 9, P.359). A qualitative study also indicated that GPs believed that falling or perceived risk of patients falling was a barrier to using OAC (Kirley *et al*. 2016). This review also found a further five papers indicating that patients with a history of falls were significantly associated with non-use of warfarin (White *et al*. 1999; Gallagher *et al*. 2008; Ewan *et al.* 2012; Holt *et al*. 2012; Clua-Espuny *et al*. 2013). Falling, specifically in older patients, was examined in two studies set in care homes (Jacobs *et al.* 2009; Bahri *et al.* 2015). The first study examined antithrombotic use of older NVAF patients (mean age 82 years) in nursing home settings which were assessed to be at higher risk of falls and increasing cognitive decline (Jacobs *et al.* 2009). Their findings indicated that only 6/112 (5%) of all eligible patients were not receiving any antithrombotic therapy, with 33% and 50% of patients aged older than 85 years, using warfarin and APL respectively (*p* not stated). Furthermore, of those patients taking antithrombotics, 80% took warfarin and a further 14% took APL. A significant difference was found overall in the patients taking warfarin and APL who had a history of falls, with 69% of APL users having had falls (12% versus 69%, *p* 0.001). This result suggests that APL may have been considered as an alternative to warfarin in some, but not all older patients, even though the risks of bleeding are potentially as serious as warfarin.

A later study of 1,085 French nursing home residents with NVAF (mean age 87) also found that patients with a history of falling were nearly 5 times more likely to be not taking warfarin, compared to patients who didn't fall ([OR: 4.9, 95% CI; 2.2 to 9.9, p <0.001] Bahri *et al.* 2015). These findings, contrast with studies that have examined bleeding outcomes in patients with falls, which show that the risk of stroke mostly outweighs the risk of haemorrhage in patients at risk of falls (Man-Son-Hing *et al*. 1999; Gage *et al*. 2005; Garwood & Corbett 2008). Therefore, it is possible that GPs are overestimating their concerns about falling in OAC decisions.

This is exemplified by a more recent UK study of the general-practice research database pertaining to nearly 700 general-practices which assessed high-risk NVAF patients for OAC use, across the period between 2012 and 2016. This study found that falls were a highly significant factor for either receiving no OAC, versus any antithrombotic therapy (OR: 1.20, 95% CI; 1.13 to 1.28, p <0.0001) and/or, receiving aspirin versus warfarin (OR: 1.14, 95% CI; 1.08 to 1.20, p <0.0001) (Lacoin *et al.* 2017). The significance of this finding on UK general-practice is important, considering that after 2012 UK GPs were encouraged to use HASBLED-scoring as part of the risk/benefit analysis when deciding OAC treatment (NICE 2014). It is likely that GPs are using more informal risk-assessments as well as (or instead of) the HASBLED score when making decisions about OAC (Kirley *et al*. 2016) as the HASBLED tool does not refer to a history of falls or risk of falling.

UK guidance for OAC prophylaxis has also recommended that OAC should not be withheld from patients solely because they are at risk of falling (NICE 2014). This is based upon previous prospective studies which have all stated that whilst age and falling increases the risk of serious bleeding, this should not directly influence decisions on whether to prescribe OAC therapy (Man-Son-Hing *et al.* 1999; Gage *et al.* 2005; Donzé *et al.* 2012).

DOAC drugs may however help to relieve GP anxieties around the bleeding-risks through falling. A further meta-analysis has also provided positive evidence of an increased safety profile of anticoagulants including DOAC drugs (Caldeira *et al.* 2015). DOAC drugs still posed a greater risk of bleeding compared to placebo (RR 3.31, 95 % CI 1.59 to 6.90, $I2$ 0 %). However, DOAC use did result in improved safety outcomes of reducing the risk of serious

intracranial haemorrhage compared to warfarin ([RR 0.44, 95 % CI 0.36 to 0.54, I^2 37 %] Caldeira *et al.* 2015).

However, this is of little use if GPs are not going to be persuaded to use them in practice. For example, one paper which surveyed a multidisciplinary group of clinicians, found that only the minority (12%) of primary care physicians believed that DOAC therapy was more effective than warfarin. Furthermore, significantly fewer primary care physicians (10.3%) also thought that the reduction in cerebral bleeding-risk was a justifiable reason to use DOACs ([*p* 0.000013] Leung *et al*. 2017).

As elderly medical practice often revolves around managing complex multimorbidity, there are recommendations for clinicians to focus on both the patient's cognition and functional abilities (Alagiakrishnan *et al*. 2018). Therefore, it may not just be the presence of falling that is the important factor when deciding OAC in per se. The reasons why GPs do or don't prescribe OAC are then complex and often studies seem to fail to capture data necessary to explain the OAC levels found (Scowcroft *et al*. 2012). Furthermore, the role that the GP plays in OAC initiation will be underpinned by their attitudes to various factors relating to OAC use.

2.6 GP role in initiation.

Several papers reported on how GPs were involved in early AF diagnosis and assessments. For example, an assessment of a large urban Canadian general-practice, found that 95% of patients with NVAF, had visited their GP in the previous twelve months before diagnosis, and a further 30.4% of these visits, related to AF (Valentinis *et al*. 2014). A further study of 8 UK general-practices in 2010, examined both initiation and maintenance of antithrombotic therapy, in 825 NVAF patients (Kassianos *et al*. 2013) with the main findings of interest being, that GPs were involved in 81% of initiation visits, compared to 63% of any patient visits during initiation of treatment. GPs were also found to be more involved in the maintenance of antithrombotic therapy, with 88% vs 56% of maintenance visits made into primary and secondary care respectively. Although this data doesn't confirm who took the decision to prescribe OAC, it does indicate, that the GP is very often part of the processes involving both initiation and maintenance stages. Despite this, only 75.5% of patients in the initiation phase, and 87.7% in the maintenance phases, received antithrombotic therapies,

suggesting that more patients could have been initiated onto antithrombotic treatments quicker, by the GPs.

However, this UK study may not be typical, globally of the GP role. For example, a study of a USA primary care insurance claims database, between the years 2010 and 2013, examined NVAF patient's first diagnosis. The GP was found to be the initiator of prescription of OAC in 32.5%, with a further 37% initiated by a cardiologist (Willey *et al.* 2018).

A further prospective multinational study of patients who had experienced a first stroke, who were also known to have NVAF, was used to explore reasons for non-treatment with OAC, prior to stroke (Deplanque *et al*. 2004). The main findings here were that 67% of the sample were described as eligible for OAC (high-stroke-risk indicated by $CHADS_2$ risk -score and with no contraindications), yet only 22% were found to have been treated at the time of the stroke. Multiple factors were found to be present on univariate analysis for both increased and decreased use of OAC. Of note, if the GP had been the main prescriber, then the likelihood of warfarin was significantly reduced (OR: 0.38, 95% CI; 0.22 to 0.66, p <0.05). However, younger GPs, were more often prescribing warfarin (Yes= age 48±1 versus No= 50±1, p 0.0016) which may represent historical attitudes to OAC practices. Overall, GPs made more decisions to not provide OAC than cardiologists (139 vs 81).

To summarise, GPs do appear to see more AF patients, more often than their secondary care counterparts, and are well placed to both make AF diagnoses and offer OAC treatments. Yet they seem to be reluctant to take on this responsibility. This may be impacted upon by the GP attitudes towards OAC use in general.

2.7 GP and OAC decision-making.

This review found only a limited number of studies that specifically explored GP attitudes towards OAC use in practice, most being over ten years old. For example, a qualitative study of twelve UK GPs, who had an interest in research, was undertaken using a constructivist approach to investigate how GPs made OAC decisions (Lipman *et al*. 2004). A thematic framework was created which accounted for the factors that the GP respondents understood to affect their decisions about OAC. Two main themes were created from the data which included "*evidence in practice*" and "*professional roles*." They found that the use

of guidelines and evidence relating to OAC use were important factors in both the use and non-use of warfarin. The GPs expressed doubt about applying the types of available evidence into their routine daily practices, which also resulted in differing attitudes regarding the use and implementation of clinical OAC guidelines. This may have been affected by the GPs' personal knowledge about how to interpret and communicate stroke and bleeding-risk to patients, which was described, at times, as being "*haphazard*". Some of the GPs in this study favoured the role of the patients in making decisions about OAC, encouraging patients to make informed decisions. However, some of the GPs also felt a "*failure*" if patients had chosen to avoid OAC when it was otherwise clinically indicated.

How GPs, together with patients, make decisions about OAC, has been the subject of several other qualitative studies. In a study which was undertaken in a USA primary care practice, exploring the views of twenty-one NVAF patients and their reasons for taking warfarin, different themes were described such as "*decision-making*", "*knowledge and education*", "*impact of warfarin*" and "*patient's satisfaction*" (Dantas *et al*. 2004). This practice was situated within a hospital, and patients could have been dealt with either routinely, or in emergencies. In contrast to the findings in Lipman *et al*. (2004), Dantas and colleagues (2004) found that often, patients had experienced minimal input in decisions to start warfarin, often on reflection, placing full trust in the care of their physicians and/or feeling constrained by the circumstances that led them to having initial treatments. The constraints documented here may be more representative of patients who present with acute illness and this is more likely to differ from UK, GP consultation models, whereby, those in need of urgent care are transferred into a hospital setting. However, there may be other "*constraining*" factors that patients may face in UK GP consultations, that need to be established by asking such questions as, "*how are patients involved in OAC decisions in a GP consultation now?"*, and "*what levels of trust or what factors define trust for patients in their GPs who initiate and prescribe OACs to them?"* Dantas and colleagues (2004) for example, determined that patient's levels of OAC knowledge use, varied from nil, to minimal. It was suggested that patients appeared to mostly lack any real understanding about OAC medications and failed to recall if they had ever been given any information on initiation. Furthermore, the patients in Dantas *et al*. (2004) also reported, that the lack of knowledge about warfarin, didn't seem to matter to them. However, this finding may not have applied

to those patients not taking warfarin, as these were excluded from this study, or, to those now taking DOACs, which weren't available at the time of the previous two papers.

Other evidence however suggests that underlying patient health beliefs are important factors in their decisions to undertake OAC treatment. For example, an earlier qualitative study, involving 56 NVAF patients, in a single large UK general-practice, was used to explore stroke-risk, eligibility for OAC use, and patients' preferences based upon the prevailing clinical trial recommendations (Howitt & Armstrong 1999). In total, 132 patients with NVAF were identified, which after exclusions and refusals to the study, resulted in a sample of 56/132 (42.4%) of eligible patients. Of these, 44/56 (76.5%) were already taking warfarin, which after an intervention to increased OAC use was applied, led to a further 17.8% commencing warfarin. Significantly more people who refused to attend were described as frail and or had a history of falling and stroke (*p* 0.005). Howitt and Armstrong (1999) also identified several patient health-beliefs, which negatively affected the choice for antithrombotic treatment, including the belief that they were not at risk of stroke at all. Further health beliefs expressed by patients, included passive attitudes towards death, including an acceptance of death by stroke as a reason to not initiate warfarin. Conversely, a desire to live longer was also used as a reason to start warfarin. The final health-beliefs involved factors concerning attitudes around change. These included patients' fears of change as they perceived themselves to be "*well*", which acted as a reason to not commence warfarin. Similarly, patients who were taking warfarin did not wish to stop, for fear of causing a stroke.

A further systematic review also examined the importance of patients' preferences in choosing and adhering to OAC use within an expanding range of OAC treatments (Wilkes *et al*. 2016). The main findings of this review were that patient preferences for OAC must be balanced by "*the burden of treatment*" which also included factors such as the efficacy/harm effects, as well as the financial and social aspects of treatment for patients (Wilkes *et al*. 2016). Wilkes and colleague's (2016) review included 27 papers, 59% of which examined patient preferences around stroke versus bleeding-risk acceptance, and whose patient samples originated from both primary and secondary care organisations. Of the papers included in the above review, 44% of the studies included data to choices specific to

OAC treatment types but didn't indicate actual clinician involvements. The findings showed that patients, when given a choice of various stroke-risks versus bleeding-risks, would be willing to accept a lower absolute stroke-risk to commence OAC, compared to that of their clinicians. Furthermore, they also suggested that stroke, rather than bleeding-risk was the more important factor to patients, the inverse for clinicians making OAC decisions elsewhere (Man-Son-Hing *et al*. 1996). Other pertinent factors for patients involved issues such as, the convenience (or not) of blood testing, the number of drug and dietary interactions (Wilkes *et al*. 2016).

A further pertinent paper not included in the Wilke *et al*. (2016) review, which was set in a community geriatric outpatient-clinic, examined how information giving concerning stroke and bleeding-risk, affected older patients' decisions about OAC use (Fuller *et al*. 2004). In total, the study included 81 patients, over half of which chose not to take OAC. Fuller and colleagues (2004) found that again, patients had fixed health beliefs that shaped their attitudes, including those about stroke and bleeding, which were important when deciding upon OAC treatments. Key themes emerged in this paper, which are described as, "*attitudes to risk" "gambling", "trade off"* and "*guarantors"*. In explaining these themes, Fuller *et al*. (2004) refer to patients, enacting the balancing of risk around lifestyle measures, such as, alcohol. Whereby, if the patients desire to drink alcohol for pleasure was greater than their wish to prevent a stroke (which was risk-based), then no initiation of warfarin would prevail. Furthermore, gambling the risk of stroke, versus the risk of cerebral haemorrhage, was also a key factor in decisions about warfarin. For some, the preservation of life and the consideration of self-perception of aging well was a factor in choosing OAC. For others, it was about the guarantees that OAC could not afford, having known others suffer the consequences of bleeding whilst on treatment.

This latter finding was also supported elsewhere in Howitt & Armstrong (1995). In contrast to the constraint themes identified by Dantas *et al*. (2004), whereby patients had or desired little or no input over the decisions to initiate warfarin, (which may have been influenced by the nature of their health state at the time), Howitt and Armstrong (1995) found that OAC levels and the patients included in this study, were constrained by health-beliefs that pertained to wellness, acceptance of stroke-risk and consenting to initial assessment.

Although the intervention used was described as successful at increasing OAC uptake in those deemed eligible, there was no discussion or comparison made of the nature of usual practice. Therefore, the exact nature of influence on the increased uptake of OAC cannot be determined. How GPs in real-world settings and practices operate in patient/GP-consultations when discussing AF and stroke-risk, when making decisions about OAC requires further elaboration. In Lipman *et al*. (2004) for example, the GPs appeared to be more inclined to include the patient in the decision-making about warfarin use. Furthermore, in some cases, even more positive about enabling patients to make the decisions which Lipman *et al*. (2004) implied, was to relieve GPs of taking responsibility of the decision, in view of the potential harm possible, through using warfarin therapy.

Taking responsibility for decisions about OAC, which also included apprehension about patients' satisfaction and ongoing management, were important factors that concerned the GPs regarding their roles in OAC care. As such, the influence and role of hospital specialists was emphasised, as if to establish, the GPs' beliefs about the complexity surrounding OAC use, as perceived as being something best managed in specialist services and not in general primary care practices. To some extent, further evidence also supports the notion of the influence of specialists and of the need for supporting GPs in OAC management in AF care. A population survey, involving 425 NVAF patients and their GPs, was undertaken to investigate physician knowledge comparing GPs to specialists about antithrombotic therapies (Anderson *et al*. 2005). This study excluded patients if they had dementia, lived in nursing homes, or if their GP had refused to allow entry into the research study. The main findings where that 69.2% of all patients, were using warfarin (either alone or in combination with aspirin), and a further 20% took aspirin alone. However, GPs were significantly less often found to be prescribing warfarin, compared to specialists (p <0.001).

To summarise, GP and patient attitudes towards OAC use, how each perceive the importance of the other in the role of decision-making, and health beliefs in general, have impacted on the general-practice uptake of OAC. In addition to this, since these papers published their findings, other factors have since evolved that have also impacted on both clinicians and patients' decisions about OAC treatment. These include modern treatment

options with DOAC drugs, and the ways which GP systems are organised to manage OAC in general-practice.

2.8 The role of the Nurse in OAC.

This review was unable to find much evidence that documented the role of nursing within the OAC management process in any setting. An early study that reported upon outpatient nurses' experiences of warfarin use in the elderly, found that nurses had minimal roles in warfarin initiation, and lacked confidence in advancing roles towards recommending OAC to GPs (Bajorek *et al.* 2006). The nurses in this paper also had detailed insight into how patients take and manage warfarin, expressing the difficulties across the primary and secondary care practice gaps, which it was reported, depended upon the enthusiasm of the GP in-charge of patient management. However, the depicted roles were mainly based around patient education and information sharing with general-practice. Only two papers documented research trialling Advanced Nurse Practitioner (ANP) led AF care, both within hospital settings. The first study found superior outcomes compared to normal care (Hendricks *et al.* 2012). This study also formed the basis for a further trial protocol in another secondary care setting, involving ANPs (Smigorowsky *et al.* 2017). However, no evidence was found relating to nursing engagement with OAC in general-practice, which might be enrolled to manage patients taking DOACs.

2.9 DOAC drugs.

There was limited data found from the papers retrieved of how the GPs perceive the use of DOAC drugs generally. However, this review found, that since the 1990's, there has been an increase in the use of OAC used in the treatment of stroke-risk in AF patients, influenced by GP attitudes and changing practices towards OAC generally. Between 1990 and 1996, warfarin treatment in patients over 65s, with NVAF, increased from 13% to 50% (Smith *et al*. 1999). A study of an Italian GP NVAF registry, also confirmed, that patients diagnosed in 2004, were 37% more likely to be treated with warfarin than those in 2001 ([OR: 1.36, 95% CI; 1.25 to 1.50, *p* 0.0001] Mazzaglia *et al*. 2010).

For GPs, the introduction of DOACs was generally guided by or directly influenced by a specialist's knowledge or decisions and other patient-specific factors. For example, a survey

of Irish GPs, between 2013 and 2014, found that 54% of the GP respondents had not initiated DOACs themselves, instead, only issuing a prescription initiated by other clinicians in secondary care (Murphy *et al.* 2018). In this study, 92% of the GPs sampled, agreed that hospital doctors, especially consultants, were an influencing factor on their prescribing of DOACs, compared to 86% of fellow GPs, and many of the factors listed were of similar importance to prescriber and non-prescribers of DOACs, amongst the GPs who responded. Similarly, an examination of a large USA primary care insurance database, which included over 20000 NVAF patients, examined the OAC use in patients taking both warfarin and Dabigatran (AbuDagga *et al*. 2014). Non-use and underuse of OAC were not examined. However, Dabigatran was significantly more often prescribed by a cardiologist, than by a GP (51% vs 30%, p <0.001). In OAC naïve patients, those treated by a cardiologist, were over 3.5 times more likely to receive Dabigatran, compared to those under the single care of a GP (OR: 3.59, 95% CI; 2.61 to 4.81, p <0.0001). A further qualitative study of specialists, also reported on the belief of some hospital clinicians that GPs seemed to have a low threshold for asking for follow up assistance from secondary-care, when it came to issues around DOAC use (Eek *et al*. 2017).

Other GP attitudes towards DOACs therapy have also influenced their uptake in practice. For example, a multidisciplinary study of USA clinician attitudes to DOAC use, found that when asked about the use of DOACs, 76% of all primary care physicians, significantly more than the other clinicians, quoted that the reduced need for INR-testing, was an important factor (p <0.0001). This was further supported by a qualitative paper which was limited by the small number of USA GPs involved, also supported the importance of specialist in the early use of DOAC on their practices around DOAC decisions, further suggesting that GPs, held certain beliefs about DOACs, such as to suggest that they were easier to use and more convenient for patients providing that they could afford them financially (Kirley *et al*. 2016). How GPs perceive the importance of patients in the decision-making process around OAC, may also been decisive in the evolution of DOAC use. However, to date there have been no studies undertaken that have explored how GPs perceive DOAC use now, which in the UK context, also involves changes to the QOF payments and NICE (2014) guidelines which favour their use.

Further papers have followed since the introduction of DOAC drugs, demonstrating increases in the use of overall OAC used, attributable to DOACs. For example, a study involving a primary care research collective of 43 general-practices, between 2011 and 2014, found a 50% increase in OAC use over the period studied, from 23.1% to 42.8% respectively, mainly attributed to the increased use of DOAC drugs (Schwill *et al*. 2018). A further paper, which supports the notion of the positive effects of DOACs, involved a prospective analysis of UK, newly diagnosed NVAF patients, managed by 186 GPs, which examined the OAC trends between, 2011-2016 (Apenteng *et al*. 2018). This study found a significant increase in the overall use of OAC over this period, from 54.7% in 2011 to 75.9% in 2016 (p <0.0001 for trend) explained by the increased use of DOAC drugs reported as 1.2% in 2011 and rising to 43.3% in 2016. Similar findings were also confirmed by another investigation into OAC trends, which found that the trend for increasing OAC use coincided with an increase in the use of DOAC and a decline in the use of both warfarin and aspirin (Lacoin *et al*. 2017). In this study, DOAC use in 2002 was just 9.8% in 2012, rising to 40.6% in 2016, whilst APL use dropped by 50% from 34% in 2012 to just 17.4% in 2016. Furthermore, in 2016 in the UK, according to general-practice QOF data, over half of all OAC were now DOACs (Robson *et al*. 2014).

However, an observation of the included papers that reported upon the trends for increasing use of both overall OAC and DOACs, did not make any assessment on how GPs are organising themselves to manage this increasing workload, or what potential interventions are being used by GPs to alter the OAC uptake within their caseloads.

2.10 Papers that used interventions to increase OAC use in general-practice.

This review only identified four studies that reported on interventions or procedures used in research designed to increase the knowledge of the GPs and/or OAC treatment, of at-risk AF patients (Oswald *et al*. 1999; Whitford *et al*. 2000; Das *et al.* 2005; Robson *et al*. 2014). This is despite, changes to UK general-practice remuneration systems (Department of Health 2011; NHS Employers 2012; NHS Commissioning Board 2013), which means that GPs are now encouraged to provide primary-care, for stroke prevention of AF patients.

The first paper was a study of four general-practices, which developed individual practice protocols to review and manage the stroke-risk of their AF patients (Oswald *et al*. 1999). In

this study, the general-practice protocols that were developed, were based upon the inclusion and exclusion criteria of warfarin RCT studies, not on specific guidance per se. Oswald *et al*. (1999) reports that it took between seven and twenty-two hours of GP time to develop the individual protocols and up to six months to implement them into practice. There were no formalised methods for the assessment of stroke and bleeding-risk then. Therefore, combining trial results, and GP personal-experience of patient's contraindications or perceived bleeding-risk into actual clinical decisions about OAC use, was subjective to the GP. It was reported here that most GPs supported the notion, that most of the AF patients should be anticoagulated to reduce the stroke-risk. However, after applying their own protocols, Oswald *et al*. (1999) found that only 11% of all patients were deemed suitable for OAC, thereby defining 52% of all AF patients on their caseloads, as ineligible for warfarin therapy. In this instance, it suggests that a self-designed practice protocol based upon the GPs' own interpretation of trial evidence restricted over half of those patients at risk of stroke, resulting in large levels of underuse of OAC.

A further study, that incorporated audit methodology to assess the initial treatment patterns of a 58 AF patient caseload found that only 63% were treated as per the prevailing guidance (Whitford & Scott 2000). This study was underpinned by some potential barriers linked to GP beliefs that the safety of warfarin, and time constraints around its management, made warfarin therapy too complicated for general-practice. OAC was therefore perceived be the responsibility of specialised secondary care clinics. These potential barriers were reportedly helped by using a phlebotomy outreach service, local agreed guidelines and the acknowledgement from the GPs that this intervention would be more effective than other such clinical assessments, where the rewards in health care were less, such as COPD screening. After completing the audit and individual patient assessments over the period of 72 months, the number of patients aged greater than 75 years with risk-factors for stroke taking warfarin, increased from 38% in 1996 to 79% in 1998. Reassessing AF patients on the caseload, was found to be time consuming, taking up to twenty clinical hours overall. This time did not include patients who were found to be not in AF (now presumed to be PAF), which will have underestimated the amount of AF and subsequent stroke-risk burden in the practice.

The final study that used an intervention to assess AF and stroke-risk-reduction in general-practice settings, employed a cardiology specialist team, supported by trained IT staff, who employed the GRASF-AF tool (Primis 2017) to examine several general-practices' AF caseloads (Das *et al* 2005). The practice that forms the location for the case-study in this thesis, was one of the sites involved in Das's (2005) study (unknowingly to the staff that were in post) and experienced the review process. Figure 4 and figure 5 below, both highlight the main findings AF patients not treated and treated with OAC from the study.

Initially, the study reported upon a review of the entire AF populations across the 56 general-practices included in this paper. Das and colleagues (2005), found a high-risk untreated AF patient population of 19.9%, which after individual patient assessment, was reduced to just 7.1% after the study implementation.

In the second part of the study (Figure 4), the intervention focused upon AF patients already taking warfarin, but whose treatment was of low quality, as measured by therapeutic time in range below 66%. After reviewing nearly ninety percent of all the patients taking warfarin, it was found that just over nine percent of patients had suboptimal OAC treatment. After individual patient reviews, 4.8 % were advised to remain on warfarin, but 2.7% had agreed to commence DOAC therapy instead of warfarin.

Figure 4. Patients identified as not taking OAC (Das *et al*. 2005).

Search criteria.	**Number (%).**	**Findings.**	**Number (%).**
AF-population.	7945	Excluding patients already on OAC; Incorrect AF read-code; AF resolved.	
Untreated high-risk.	1558 (19.9%)	Did not attend.	221 (2.8%)
Attended review.	1350 (17.1%)	No AF removed from register.	163 (2.1%).
AF confirmed.	1195 (15.0%)	Ineligible for OAC N=	132 (1.7%).
Eligible for OAC.	1063 (13.4%)	Declined/deferred OAC N=	43 (0.5%).
		Agreed to start OAC.	1020 (12.8%)

Figure 5. Patients identified as taking warfarin (Das *et al.* 2005).

Search criteria.	**Number (%).**	**Findings.**	**Number (%).**
Patients taking warfarin.	4178		
Case notes and INR reviewed.	3295 (78.9)		
Sub-optimal TTIR, invited in.	387 (9.3)	Did not attend.	66 (1.6)
Attended review.	321 (7.7)	Advised to remain on warfarin.	200 (4.8)
Offered DOAC.	121 (2.9)	Declined DOAC.	10 (0.2)
Agreed to start DOAC.	111 (2.7)		

The clinical review of patients performed by specialists in Das and colleagues study revealed that there was a pre-coded eligibility based on the general-practice data for OAC measured at 77%. After clinical assessment, this rose to 95% present eligibility (p <0.0001). Eligibility for OAC increased after applying more up to date stroke-risk and bleeding-risk assessments to the caseload under review. If these findings are generalizable, it increases the possibility that there exists a large undertreated eligible population of AF patients within general-practice caseloads. Furthermore, assumptions made about OAC rates from findings using general practice data to date, do not accurately reflect the real-world levels of AF-risk due to research lag. Therefore, any retrospective analysis of general-practice data sets that this review identified, may be under-represented by some 20%, if this study findings are applicable in any of the other study settings. Furthermore, clinical practices focus on changing clinical priorities, which also take time to implement. Therefore, underestimating OAC eligibility may be just one factor in explaining why OAC underuse exists within GP caseloads.

A further factor of concern to GPs may be how they would be able to manage the subsequent burden of hidden OAC workloads. To explain this, I use the example of the experience from the general-practice which is later the focus of this thesis case study. Unbeknownst to the staff in our practice, Das and colleagues (2015) undertook their internal patient review in our practice as part of a research study, with the aim of maximising our practice's OAC uptake within our eligible AF population. The assessment process led to the conversion of several patients from warfarin to DOACs, whilst also initiating several new OAC treatments. However, our experience of this process was that they also did this knowing that at that time, there were no formalised systems in place for ongoing patient reviews for people taking DOACs. Furthermore, there were no attempts made to organise or advise the GPs in this regard.

Communicating OAC decisions, seeking agreements with GPs and specialists over OAC decisions and establishing whether OAC decisions are or may be challenged in clinical daily practice is also less understood, as most studies do not publish data on how much of an effect hospital originated decisions have of the OAC rates papers published in primary care

based. For example, a further qualitative study of secondary care clinicians was undertaken to explore and understand any factors that were involved when making OAC prescribing decisions, particularly the differences in the factors that are used between warfarin and DOAC drugs (Eek *et al*. 2017). Although this study was primarily a study of secondary care clinicians and their approaches to OAC use, the findings revealed some important evidence relating to their perceptions of the role of the general practitioner when deciding on OAC management. The study found that conversion from warfarin to a DOAC drugs was more often done in a hospital setting, and without any knowledge about previous INR treatments or interactions, or without communications with the patient's GPs until after the decisions were undertaken. They also expressed further concerns about how the GPs follow-up DOAC care was organised, often perceived to be led by the patient themselves and not the GPs. This is a particularly important current finding as the introduction of DOACs, when initially undertaken in hospital settings, and now commonly used in primary care, were not implemented under any OAC management model in the UK other that what is recommended in the manufacturer's instructions. As GPs have become more frequently exposed to requests for DOAC prescriptions, it seems only reasonable that they should ask for more knowledge and information from more experienced clinicians to facilitate onward care, which is expected of the general-practice systems. However, this review was unable to find any evidence that explored the ongoing management of patients that had been commenced on any DOAC medicines in primary care. As such, I suggest that this aspect of the GP role in OAC prescription provision also requires further exploratory investigations for the presence of any possible factors, which general-practices may experience towards OAC implementation practices.

2.11 Discussion.

This literature review identified studies involving primary care, published between 1997 to 2018, which demonstrated OAC use. Further, it examined OAC outcomes pertaining to key patient, clinician and organisational factors for OAC use.

The review found that levels of OAC varied over time and had generally increased over the period covered in this review. However, the literature review also revealed four key findings relating to general-practice OAC use which are either missing in the data from the literature

review, and/or, do not fully explain the general-practice contribution to OAC use depicted in OAC rates published. These are: 1) There is no consensus as to what OAC underuse actually is in relation to general-practice; 2) The OAC use data presented in primary care studies are not unique to primary-care; 3) Reported OAC use does not reflect the GP or general-practice roles in OAC management; 4) OAC use in general-practice is likely the result of complex interactions of multiple factors not fully explained in the current literature.

These four findings need further discussion in specific relation to the roles within and of general-practice OAC use and the development of this thesis, which will be expanded upon next.

Firstly, claims of general OAC underuse have been previously made by numerous writers, affecting potential stroke prevention and this itself is dependent upon AF detection and coding within the collated studies. A study that examined the electronic records of five health care systems found significant differences across AF coded diagnosis, associated comorbidity and treatment outcomes (Shah *et al*. 2020), which raises questions about comparability between clinical systems used across studies and over time.

Nevertheless, it was important to establish the extent to which this occurred specifically in general-practice and to understand the GP and nurse roles and other factors in OAC use. However, this review found that there was no consensus for a definition of underuse and/or exploration of general-practice role in OAC uptake. Furthermore, claims of underuse may be incorrectly applied to data relative to historic decisions that have been made at different times and against different recommendations. Both findings question the value of claims made about underuse within the papers that publish them.

Defining OAC underuse therefore seems illogical and self-explanatory, but a benchmark is required for general practices. The lack of a defining consensus of OAC underuse, and/or the expected levels of OAC use in each AF population, has made it difficult to assess the extent of the general-practice roles in OAC uptake.

Consider, for example, the notion that OAC underuse is affected by changing national and international guidelines that requires clinical reassessment and implementation; such is the nature of clinical research into practice lag.

Secondly, most OAC use data found in this review pertaining to general-practice related to measures of OAC prescription data. Most of this data was originated from various databases whose data is also cited in studies that are based in secondary care settings. Thus, the findings relating to patient characteristics were generally and unsurprisingly similar. This data and the subsequent findings therefore didn't really explain if GP assessed patients have specific factors affecting their stroke-risk reduction options and outcomes.

Thirdly, the implications of the data found in this review, which is not specific to the general-practice approach to OAC management beyond prescription data, means that the findings in this review are not a true representation of the general-practice use of OAC. Thus, evidence is lacking to support the notion that general-practices are themselves deciding upon and delivering the necessary AF/OAC care. Therefore, the general practices need to demonstrate that they have developed knowledge and skills to perform independent appraisal of risk, managing it accordingly themselves. Also, differentiating the general-practice roles in prescribing ongoing requests for OAC, and their roles in making stroke-risk reduction decisions is important, as it may be key to reducing the levels of OAC underuse so often reported.

Fourthly, in secondary care settings, various factors have previously been cited as potential barriers for OAC use. Several similar factors were also identified here. However, understanding the rates of OAC use and underuse in general-practice were complicated by methodological research factors and seem to be more complex in nature. For example, the rates of OAC usage and underuse that were published were determined by both study eligibility criteria and eligibility and measured against the prevailing antithrombotic recommendations. The earliest paper in this review, for example, investigated how the application of trial inclusion/exclusions criteria, might affect the levels of warfarin use in general-practice caseloads (Sudlow *et al*. 1997). Subsequently, a further 36 guidelines, opinions and or treatment objectives were quoted within the papers retrieved to enable the reader to judge how OAC was being used. The differences in the guidelines incorporated in the studies retrieved since Sudlow *et al*. (1997) evolved around the definitions of risk of stroke (and later bleeding) and the use of warfarin (later including DOACs) and/or APL therapies. Furthermore, some of the papers referred to treatment by eligibility and of

guideline adherence. Therefore, in assessing the papers for antithrombotic drug use, I had to research further the prevailing referenced benchmarks for drug use. Contemporary guidelines revealed that most NVAF patients should be eligible for OAC treatment, which also required a formal judgement to include balancing the estimated risk of stroke against the risk of bleeding. Therefore, estimating the levels of underuse based upon contrasting guidelines of OAC in this review was found to be difficult to compare over time. Therefore, I attempted to group the papers that had included OAC use data from broadly similar periods or those that quoted the same kinds of recommendations, to enable a more meaningful comparison. However, there remained contrasting study eligibly based upon patient-specific factors which would otherwise, normally, affect routine general-practice OAC decisions, based upon what are common patients on general-practice caseloads.

Examples of exclusions to individual studies included factors such as housebound patients (Abdul-Rahim *et al*. 2013), nursing home patients (Smith *et al.* 1999; White *et al.* 1999; Anderson *et al.* 2005; Abdul-Rahim *et al.* 2013; Hannon *et al.* 2014) and paroxysmal AF (FALSTAF study group 2000; Ruigómez *et al.* 2002; Pusser *et al.* 2005; Gallagher *et al.* 2008). Usually, papers that placed restrictions on their samples didn't provide a rationale unless specific to the study aims. Thus, relating these findings to practice is troublesome. However, it also highlights the need to explore such specific factors as potential barriers to OAC use in contemporary general-practice.

The literature review revealed various research aims and objectives that captured data pertaining to seventy-six different unique study variables. Some of these variables showed repeated associations with both use and underuse of antithrombotic therapies. Ageing and dementia, for instance, were both found to be exemplars that reduced the likelihood of OAC use in many studies. However, in several papers that specifically sampled older and housebound patients, many of these patients were found to be taking OAC, meaning that the label, or diagnosis itself, is not enough to explain why other patients were less likely to be taking OAC.

Papers that included qualitative methods were also included in this review, and these were more likely to include data about patient and clinician attitudes, and beliefs around OAC use and between patient/GPs relationships that lead to decisions about OAC use. Themes that

emerged from GP interviews also included relationships with secondary care services, particularly around the sharing of information and taking direct responsibility for OAC decisions.

I undertook this structured literature review applying rigour throughout the stages of the review process to the best of my abilities, given my experience, and the resources available to me. I have however, identified several limitations whilst undertaking this review and these will impact on the reliability of the results. Firstly, there is the possibility of several forms of bias (Jadad 2000) due to my single-researcher approach, and which could have occurred at each stage of the literature review. For example, selection bias might have occurred as I personally searched and assessed the literature's suitability for inclusion. To compensate for my personal bias, whenever possible, research supervision was used to discuss the papers and the processes involved in this review. However, I acknowledge that the validity of this review will be impacted upon the likelihood of my biases, such that it is possible that other potentially relevant papers and or findings may have been missed which detracts from the quality of the findings.

Secondly, I was also independently responsible for data extraction. A lack of resources constrained data verification quality with other associated researchers. This would have increased the reliability of the results presented. Forming new groups, from non-identical constructs during the data extraction phase may have also been subject to researcher bias. But this was usually undertaken in partnership with the research supervision team, where a consensus was sought.

This review also included no non-English language translation of papers as resource constraints further prevented me from including papers in other languages, which may have reduced the scope of the review. I also limited this review to exclude RCT methodology, which may have yielded far more information about possible interventions that might impact on general-practice OAC use. I also acknowledge that these papers may have contained data directly or indirectly relevant to the aims of this review. Likewise, the findings in this review may not be directly applicable to NVAF patients in non-primary care settings. It is perhaps not surprising, that the factors that have appeared to be related to OAC use and underuse in this review are like those identified in other reviews, which include

secondary care studies (Ogilvie *et al.* 2010). This may be because, essentially, the same data sources and variables are often used in establishing the factors that are related to OAC use such as prescription data, contraindications and patients' exclusions in papers relating to or inclusive of secondary care OAC practice.

This work has shown that commonly accepted factors for OAC use and underuse are more complex in nature, and therefore may require further clarification in general-practice. The findings here have also identified that there are gaps in the reliability of knowledge about how GPs are involved in the process of AF care, from first presentation, to management decisions, and how they organize their own services towards this practice.

The results of this review are reassuring, in that they show a progressive increase in the use of preventative measures for NVAF patients at risk of stroke over time. Yet, there remains scope to improve this further according to the most recent data from primary care practice. Previously, the qualitative evidence available reported GP concerns about undertaking any role in OAC and about taking responsibility for OAC decisions. Secondly, it seems that patients often lacked knowledge about OAC before and after OAC initiation, whilst also being more inclined to trust their GPs' recommendations. Yet, patients were also more likely to accept OAC treatment at lower risks for bleeding to prevent strokes than was acceptable to the GPs on whom they depend upon for their decisions. General-practices may therefore consider these findings relevant and useful to their own NVAF caseloads, as a means for benchmarking over time. Furthermore, this literature review may act as an initiator for clinical discussions about improving general-practice approaches to OAC use in this patient group. However, more explanatory evidence is required to further understand how general-practice underpins the OAC use, found in this review.

The literature review revealed various levels of OAC use and potential underuse. However, it also found that the reasons why GPs do, or don't prescribe OAC, are both complex and often studies often failed to capture data necessary to explain the OAC levels found (Scowcroft *et al*. 2012). For example, the evidence in this review does not explain GP engagement with stroke prevention practice, other than those measured by prescription rates of antithrombotic therapies. Only one study (Kassianos *et al*. 2013) was able to identify the general-practice as being the initiator of OAC, whilst only one further study was able to

describe the length of times GP-patients waited for OAC initiation (Kassianos *et al*. 2013). Furthermore, qualitative studies that were available lacked both any contemporary insight into general-practice approaches to OAC decision-making, given the introduction of stroke and bleeding-risk tools, electronic dosing decision aids, and the introduction of DOAC drugs. Only one further study examined OAC rates in line with changes to the QOF changes (Robson *et al.* 2018). However, this paper was unable to explain how the general-practices organised their routine work practices around OAC care, now that they have the added responsibility of OAC management, as determined by the changes to the QOF.

This literature review is a contemporary examination of primary care NVAF-patient use of antithrombotic therapies, which included papers published over a twenty-year period. Over this period, the evidence shows that approaches to stroke prevention have changed dramatically and there appears to have been advances in the uptake of OAC. This has been enabled by evolving guidelines, based upon improved evidence that have both clarified stroke and bleeding-risk, but also have redefined the nature of antithrombotic treatments by now excluding any use of APL in stroke prevention. However, the advent of DOAC drugs has been associated with reductions in the use of both warfarin and APL drugs, while there remain levels of unexplained OAC underuse (Lacoin *et al.* 2017). This is, perhaps, related to the increasing prevalence of NVAF itself, but has also been partially explained by the acknowledgment that more patients in general-practice than ever before, are potentially eligible for OAC therapies (Jain *et al.* 2017). This will be explored within the following chapters of this thesis.

This review found some consistent factors that were related to the likelihood of historic undertreatment with OAC and the increased likelihood of APL or no treatment. However, even with patients who had had these clinical and non-clinical factors, there remained many examples within the data where it appeared that decisions about OAC were more complex than to be explained by individual factors. There were also areas of paucity within the evidence found from the studies that had investigated or presented findings about OAC use. These included the actual GP and other general-practice roles within modern OAC management systems. Specifically, factors relating to the nature of how general-practice AF caseloads are organised and what factors may now be affecting decision-making approaches

with patients. These factors are particularly important to understand in view of the changes in expectations that are currently attached to the general-practice through QOF and improvements in the choice of anticoagulant therapies that are now available to GPs and their patients. The role of general practice, and the roles within a specific general practice, therefore, need to be explored further. These roles will be analysed in relation to AF/OAC care in the following chapters of this thesis.

Chapter 3.

3. Methods section.

The previous chapter has highlighted substantial evidence that stroke-risk reduction of AF patients in primary care is both complex in nature, and inadequate in practice. The literature review explored claims of OAC underuse in primary-care, but was unable to explain further how, and why, general-practices adopt and manage systems that result in the OAC use that was described. Further research was therefore planned to explore these findings, and to develop knowledge that could lead to a suggestion about possible factors for an OAC practice intervention, aimed at improving OAC uptake.

This chapter of the thesis presents an original contribution to knowledge in three ways. Firstly, it uses existing methodologies within a new setting and secondly, combines them to enable the formation of a new model of general-practice OAC care. Thirdly, the insider-researcher approach is presented as a new method for general-practice OAC investigation. The significance of this chapter relates to the expansion of knowledge of the methodologies within their existing repertoires, and also to the promotion of clinicians as researchers, either actual or potential, in general-practice settings.

This chapter therefore presents, and explains, the ontological, epistemological and methodological approaches that underpin this thesis. The second section of this chapter describes and provides a rationale for some research methodologies, which were perceived to be important, in answering the developing aims of this thesis. The use of a realist philosophy, more situated within an interpretive positivist-constructivist continuum, and applying mixed-methods, was used in this thesis. Furthermore, a realist approach using an insider-researcher lens was employed to collect data, which included the use of a Normalisation Process Theory (NPT) method, and which are discussed in further detail. Finally, exploration of possible behavioural change components for an intervention model, to increase OAC used in general-practice is proposed.

3.1. The research paradigm underpinning the study.

This research is underpinned by personal experiences of being a nurse, studying and working within the same context, employing reflexivity. Therefore, I have chosen to present

this thesis using an active voice. It is simple plain language that people understand and is an acceptable form of scientific communication in qualitative research (Creswell 2012; Ritchie *et al*, 2014). The research paradigm was a framework of the perspectives that influenced the development of this study (Don Moyer 2008) and sits within a realist philosophy which will be outlined next.

The aims of this thesis are underpinned by a basic set of personal beliefs around specific ontological, epistemological and methodological questions which together, form the paradigm that led to the subsequent research actions (Guba 1990). Various perspectives were considered during these studies; however, there appears to be a growing interest in developing the use of critical realism as paradigm in nursing practice research (Williams *et al*. 2017). According to Sayer (2012, P.19),

> *"…Compared to positivism and Interpretivism, critical realism endorses or is compatible with a relatively wide range of research methodologies……Choice of methodologies should depend upon the nature of the object of study and what one wants to learn about it.* "

Therefore, critical realism was the paradigm that emerged from my own analysis about considerations concerning the meanings of truth, knowledge and the values of the discipline under study (Schwandt 2001). This self-analysis included responding to both the gaps in the current knowledge identified around general-practice use of OAC, and how these may be best met within a specific methodological framework (Wagner *et al.* 2012). This point is highlighted by the influences of both the study objectives, and the relationship of the researcher to the subject under study. The aims of this thesis required me, in developing this paradigm, to acknowledge the complex nature of both OAC use and any subsequent interventions that may have be implemented to address changes designed increase the use of OACs today. The notion of what constitutes a complex intervention is, itself, complex, with multiple expressions of what this means for healthcare. One definition which corresponds with my realist epistemological position, is one of a complex intervention's composite of different parts, each with generative capacity and/or with subsequent emergent properties. Each of these parts, which can take many forms, when combined within a context, form the basis for a complex intervention, as Clark (2013, P.185) explains:

> *"…Complex interventions are defined as being composed of parts that make the whole intervention and in isolation or combination, can generate the power of the intervention. Complex interventions should be defined as being formed of parts, which can be material, human, theoretical, social, or procedural in nature, possibly stratified into higher and lower realms, which exercise power individually, in combination, or as emergent properties."*

Therefore, the introduction of new OAC management processes into a general-practice is, for the purposes of this thesis, considered to be, a complex intervention in practice consisting of several parts, as described by May *et al* (2007, P2.):

> *"…A complex intervention is defined as a deliberately initiated attempt to introduce new, or modify existing, patterns of collective action in health care."*

The paradigm also emerged because of my position as a practitioner - student researcher. This is of critical importance to the reader, as the underlying aims of the research activity for the insider-researcher, differs from other forms of research and researchers, whose aims are embedded in outcomes of contributing to a body of purely academic knowledge. Whereby, insider-researchers, are more orientated to explaining or problem-solving issues around practice, designed to also increase the body of professional knowledge (Reed & Procter 1995), which Reed and Proctor (1995, P11.) further describe as:

"…A practitioner undertaking research into their own and their colleagues' practice",

the benefits and potential restrictions of which, will be discussed in more detail in sections 3.2 and 3.3.

The next part of this chapter will describe the four aspects of the research paradigm, which is the foundation for the thesis (Crotty 2003). This constitutes my perspectives on ontology (how we define what is real (Sayer 2012), epistemology (theory of knowledge (Sayer 2012) and the theoretical perspectives, which have been chosen to guide the thesis. The final section of this chapter will describe, and explain, the methodological approach taken in this thesis. In so doing, I will outline my rationale for choosing the methods used and highlight any implications for the research undertaken.

The ontological and epistemological perspectives of this thesis are grounded in critical realism (Bhasker 2008) and are developed further through realist social theory (Archer 2003). Critical realism assumes that the nature of reality (ies) cannot be simply asserted to be experiential and thus, only observable, in nature (as with positivistic ontology). Nor can the reality (ies) be only interpretable in nature. For the critical realist assumes, that what exists, does so independently and despite of the observer. But what is real also requires an interpretation. However, realist social theory develops critical realism further with the aim of explaining social realities (Archer 2003).

Critical realism also asserts a stratified ontology or stratified realities instead of being flat (positivism and interpretivism) (Bhasker 1978), which according to Kessler and Spilsbury (2019):

> "…Are founded on generative causative mechanisms that explain patterned outcomes from structure-agency interactions."

Three possible states exist; firstly, there is the real which concerns the definitions of objects and their potential powers. Secondly, there is the actual, which is to describe what happens if, and when, such powers should be triggered. Social realist theory reflects this via the roles of potential or enacted power and emergent properties that social agents have and play within a social context (Archer 2003). Finally, there is the empirical, which lies within the experiential realm of what can be observed or measured (Sayer 2012). Critical realism is also founded upon the understanding of the concept of emergence, whereby the coming together of two or more objects' potential combined-characteristics, result in new phenomena, which have unique properties, yet are only emergent due to the actions of the mechanisms of their constituent parts (Sayer 2012). Whereas, social realist theory is bound to also identify emergent properties of both people and structure whose mechanisms are often hidden or latent. Therefore, in critical realism and social realist theory, the aim is to understand the nature of causative mechanisms, how, if, and when, they are activated (Sayer 2012).

This thesis therefore concerns the study of social systems which are deemed to be open in nature, and therefore liable to change (Archer 2003). Furthermore, these open-systems are also constructed of both transitive and intransient dimensions, which contain potential

emergent-properties, of which causation requires an interpretive dimension (Bhasker 2008). So, the principles of critical realism and social realist theory will be used to frame the enquiry in this thesis. In this respect, the aim of the thesis involves ontologically identifying and determining the nature of what is real, of what is actual, as well as what is empirical, in the exploring of the causative mechanisms of the object under study here. This is explained by Bhasker, (1979, P.15) when he states:

> "…*Science must be seen as a social process, whose aim is the production of the knowledge of the mechanisms of the production of phenomena in nature, the intransitive objects of inquiry*."

This thesis therefore aims to construct a theoretical model, which explains how general-practices could use OAC effectively, to reduce the stroke-risk in AF patients. Thus, in creating a theoretical model, it was considered important to convey the theoretical approach taken in this study. Firstly, it was decided that in keeping with the underlying critical realist principles (stratified ontological realties, of causal/potentially causal mechanisms that lead to emergent properties), the use of a logic model would best illustrate my theoretical perspective (Yin 2009). The complex nature of OAC use in general-practice meant that a form of realist evaluation was considered best suited to the aims of this thesis.

Realist evaluation is a form of theory-driven evaluation, based on critical realist philosophy (stratified ontological realties, of causal/potentially causal mechanisms that lead to emergent properties), which aims to understand why complex interventions work, how, for whom, in what context and to what extent (Pawson & Tilley 2012). Realist evaluation contends that causality depends upon generative mechanisms which are in part, modified by and shared by causal relationships with agents within specific contexts (Pawson & Tilley 1997).

As such, the realist theoretical perspective aims to uncover explanations that are based upon the premise that specific outcomes in and around an intervention are the result of mechanisms that have been activated within a specific context. How people or actors enable their agency through the effects of causal mechanisms (M) requires understanding of

the context (C) or conditions in place which result in planned or unplanned outcomes (O) otherwise known as Context-Mechanism-Outcome configurations (CMOs) (Linsley *et al*. 2015).

However, defining mechanisms in realist theory and evaluative research is difficult, and has resulted in a typology of mechanisms according to the level of intervention and analysis of the research undertaken (Lacouture *et al*. 2015). As such Lacouture et al. define a mechanism as:

> "…*an element of reasoning and reactions of (an) individual or collective agent(s) in regards of the resources available in a given context to bring about changes through the implementation of an intervention*."

This definition of a mechanism is used in this thesis and can be used for the reader to assess the credibility of the findings here.

The theory-driven aspects of realism thus required me to undertake a process of heuristic investigation, to develop meaningful CMO-configuration assessments (Jagosh *et al*, 2015). Thus illuminating unidentified mechanisms within the available data and expanding identification of the relevant mechanisms for realist enquiry (Kazi 2003) and was undertaken during the data analysis phase and will be discussed later.

To determine the CMOs, part two of the thesis, is also supplemented using two more specific theoretical perspectives. The Normalization Process Theory (NPT) (May & Finch 2009) and the subsequent Normalization Process Model, is an evaluative theory and tool that addresses what people do to make complex interventions workable, and to embed complex intervention into their practices (May *et al.* 2007). Combining the NPT with realist evaluation can support research that results in "*deeper*" explanations of the factors that affect healthcare (Lewis *et al* 2019). NPT, originally developed to investigate telemedicine in the NHS, is a middle range theory that combines theory and observations to explain how complex interventions become embedded into routine practice (May & Finch, 2010; Murray

et al. 2010). There is a developing repertoire of NPT use in health care research with one systematic review citing 29 papers covering a variety of health fields and issues (McEvoy *et al.* 2014). Further recent papers relative to primary care also include service user involvement (Tierney *et al*. 2014), case management for people with dementia (Bamford *et al*. 2014), chlamydia screening (rickets *et al*. 2016), cardiovascular disease prevention (Volker *et al.* 2017), point of care testing (Jones *et al.* 2017), interdisciplinary team working (O'Reily *et al.* 2017) and embedding oral health care into community health care practices (Lewis *et al*. 2018) indicating the adaptiveness and usability of NPT as a method in primary care-based research.

Figure 6. NPT construct and components.

	NPT core constructs.			
Construct components.	**Coherence.** (Sense-making work).	**Cognitive Participation.** (Relational work).	**Collective Action.** (Operationalization).	**Reflexive Monitoring.** (Reviewing).
	Differentiation. (Understanding the difference between old and new practices).	**Initiation.** (Key people work to implement practice).	**Interactional Workability.** (Practicalities of working together).	**Systematization.** (Collecting review data).
	Communal specification. (Shared understanding).	**Enrolment.** (Organising and encouraging staff).	**Relational Integration.** (Knowledge and experience).	**Communal appraisal.** (Group evaluation).
	Individual specification. (Individual understanding roles).	**Legitimation.** (Staff believes in the new practice).	**Skill set Workability.** (Roles and expectations).	**Individual appraisal.** (Self-evaluation).
	Internalization. (Value, benefits of practices new and old).	**Activation.** (Defining roles and responsibilities).	**Contextual Integration** (Resources).	**Reconfiguration.** (Accepting or redefining practices).

In NPT, embedding of complex interventions such as OAC services, are both contingent upon agents working together, and rely upon causative mechanisms which require agent's continuous investment (May *et al*. 2015). Furthermore, NPT enables research description, explanation and knowledge claims, based upon four constructs, each of which is generated from a further four components (May *et al*. 2007) (Figure 6). Therefore, the descriptions of the NPT constructs and components (May *et al.* 2015), were used to structure the data collection phase, and the initial data analysis phase. The epistemological flexibility that is

possible with this realist approach allows for the use of more than one theoretical model to explore, and attain, the possible mechanisms involved in generative causality of both the individuals and groups (Pawson 2012). Therefore, both the NPT and realist theoretical frameworks allowed for the heuristic investigation of the CMO-configurations to emerge, which ultimately, addressed the aims of the overall thesis.

The final objective of this thesis is to identify possible behavioural change components for an intervention model, which may be relevant to supporting an intervention that would increase the uptake of OAC in general-practice. To this end, a final theoretical model is used during the analysis phase, which will be discussed more detail later.

3.2 Ontology and the insider-researcher.

Knowing how things are, how things work, and how things can become, is vital to our understanding of the world. Additionally, with these claims of knowledge and understanding comes the risk of researcher biases which are held in personal views and beliefs and should be made explicit for the reader (Bryman 2014). Therefore, as researchers potentially affect all stages of the research process, it is critical, particularly in qualitative research, to adopt a reflective or reflexive approach to one's research (Chamaz 2014.)

The methodology employed in this thesis is thus dependent upon the ontological assumptions that are placed on the world around me and via my own experiences in this world and in this research context. This thesis reflects work that is based primarily in a medical context, whose underlying driving philosophy is founded on the notion of cause and effect. However, the aims and objectives of the thesis also require an enquiry which develops an understanding, stretching the ontological pretext to include exploration of the behaviour and reasoning from a social standpoint.

This standpoint cannot be easily satisfied by an experimental methodology alone. Human behaviours and the research into them are deeply rooted in psychological and sociological methodologies. Psychological research often lends itself to experimental methodologies, however sociological studies may be more suited to methodologies whose ontological underpinnings are based upon more unique, subjective or constructivist ideologies. These

are the opposite of the causative, positivist perspectives which underpin most if not all medical research (Crotty 2012).

This research is also undertaken from the perspective of an insider-researcher, whereby I have experience of the culture under study. I also have an intimate tacit knowledge of this culture, and I will still be part of the culture once the research has been completed. Therefore, according to Reed and Procter (1995, P.6), the implications need to be outlined, as explained:

> "*…At a fundamental level, cultures affect the way in which researchers think about the world*."

This next section will therefore outline the ontological and methodological underpinnings of this thesis and in so doing; I will explain and justify decisions about the methods which have been used in the research process. Furthermore, the role of the insider-researcher will be elaborated; this has multiple elements and aspects which Coghlan (2007, P.341) explains, must be considered:

> *"... Insider-researchers need to confront the issues pertaining to pre-understanding, role duality and organizational politics. Attention to experience, understanding and judgement which leads to action, provides a methodology through which they can affirm what and how they know. They need to do so in a critical realist approach which challenges them to transcend their own subjectivity through the quality of how they are attentive to the data, intelligent in their understanding, reasonable in their judgements and responsible in their actions. Such transcendence provides the criteria for a rigorous epistemology and quality action research."*

In constructing a methodological framework, Costley *et al* (2011) comment that ontology (that the nature of being/reality, about what is possible to know) will be framed by the researcher's own position in the world, and how, thereafter, this is perceived. My own ontological perspective is framed by my place within a healthcare system, a system

dominated by medicine, where all practices spring from a positivistic lens. The truth about reality is thus assumed to only be determined by means of measuring and advocating effectiveness of treatments, and efficiencies of practices. However, my own ontological position originates from my personal understanding of the world around me, and is, on reflection, developed by the emancipatory aims of nursing, that is perhaps driven more by patient advocacy than clinical effectiveness. These concord with an insider-researcher, whose aims, for researcher, are also to challenge and improve practitioner knowledge and practice (Reed & Procter 1995). As a result, my interpretation of reality (ies), is/are, based upon more emergent beliefs, of what has formerly been described, as constructivist ontological ideas (Guba 1990). Indeed, as a practicing lay Buddhist, my understanding of the nature of emptiness means that I am also only ever going to accept that anything in this world only exists through our own (often mistaken) labelling of both meanings and assumptions. Through this lens, reality should be deconstructed to show its component parts which when aggregated, form the item of existence which we then thus label.

I am also an "*insider*" in terms of classic ethnographical research (Costly 2011). Such an insider-researcher approach must ensure credibility (Unluer 2012) and requires further exploration here. The next section will, therefore, explore and define the role of the insider-researcher and outline both the advantages and disadvantages of my role as an insider-researcher within the context of this thesis.

An insider-researcher is therefore a researcher, who is part of the social community that they are studying, which Coghlan and Brannick (2014, P.34) assert:

> *"…Inquiry from the inside involves researchers as natives and actors, immersed in local situations generating contextually embedded knowledge which emerges from experience."*

Furthermore, my role as researcher in this context is undertaken, alongside the normal duties of the insider as researcher (Coghlan & Brannick 2014). Thereby, the Insider-researcher is also a practitioner who is investigating, both his and his colleague's, own practices (Reed & Procter 1995). In this thesis I was situated within the same professional

context of the research study, meaning that the same rules, institutional values and normative practices applied to me, as it did to those under study (Coghlan & Brannick 2014).

There are advantages of asserting the role of an insider-researcher, which include, for example, the ease of access to the research field, by means of association with the study centre and group (Procter & Reed 1998). Informants within the case-study were also colleagues, whose previous relationships with the researcher enabled both access to the research field, and the informed consent necessary, to enrol the practitioners into the research process. A further advantage was my knowledge and experience of the case-study culture. This knowledge involved having a shared understanding of both the physical/structural context and the socio-political context that had been present before and throughout, the study period. My experience of this culture gave me the advantage, of understanding language and meanings of the clinical descriptions that were used, both directly and tacitly (Meerabeau 1998). This also meant that focused questioning about everyday tasks was not necessary, which avoided the informants feeling under pressure by means of clinical scrutiny, through the need to justify and explain their practices.

However, there are also potential disadvantages of being an insider-researcher. For example, the insider-researcher has a more complex permeable relationship within the context that is under study, as Griffiths (1998, P.368) explains:

> *"…If we conceive of research as a relation that occurs over time, we can begin to see that the researcher moves back and forth across different boundaries. Some of these she recognizes at the time because they are the social facts of our society (race/ethnicity, gender, sexual orientation). Other boundaries are more difficult to negotiate (social class, age, disability). Others may not become visible until much later in the research process (the conceptual framing of the research)."*

An example of this is when the researcher interviews their own colleagues, which may involve the social ranking in the research context potentially leading to coercion and unfair influence of co-workers in research participation (Unluer 2012). Furthermore, interviewing your own colleagues also raises multiple ethic issues. These include information sharing

from senior to junior members of the culture and the possibility of "untruthful information" based upon beliefs, power and relationships with the culture (Fox *et al.* 2007). Untruthful information may also be the result of positive respondent bias such as the halo effect whereby respondents give the research answers that are in-line with what they think the research wants and needs (Haddad *et al*. 2019). Or conversely, the Hawthorne effects which depicts psycho-behavioural responses to subjects who know are being studied (McCambridge *et al* 2014).

Thus, researcher-practitioner roles and permeability as described above, may be affected by the power within these relationships, and may have an independent role in the subsequent research processing that follows. Such is the emotional and ethical work of the insider-researcher (Darra 2008). The insider-researcher then, in context, is from one perspective, compounded by a multitude of complex layering, of confounding social influences (Costley *et al.* 2011). This potentially disadvantages the role of the insider-researcher, with many other such disadvantages also potentially affecting the ability to establish, and maintain, the validity and rigour of the research (Teusner 2016).

3.3 Bias and Ethical considerations of insider-research.

Bias.

The risk of bias is high using the insider-researcher approach, but this is accepted and balanced by processes used in this methodology (Forrester 2017), underlining the need to promote and maintain rigour in the research process (McConnell 2018). These issues will be discussed now in relation to minimizing research bias and later as part of the ethics application.

There are suggestions that insider-researchers have taken-for-granted assumptions, or even a lack of assumptions, about the cultures that they are engaged in routinely (Asselin 2003). A potential blind bias may therefore exist when considering the insider-researcher's personal lens in relation to the specific lenses of others' roles within the shared context (Asselin 2003). For example, I believed that my role as an insider-researcher was beneficial to this research process, as I shared intimate knowledge and experiences with those participants in this study setting. Furthermore, I also had what Davies *et al.* (2000) calls

awareness of the different professional subcultures present. But I did not have direct experience of how the GPs or other nurses viewed the OAC work and/or how they viewed this work as experienced by the effects on their daily routine workloads.

Nevertheless, it remained important to recognise what Coghlan (2019) described in the insider-researcher's role within action research as "pre-understanding" of my personal knowledge, as including personal knowledge and experience, both tacit and experiential, on the importance of the insider-researcher within this research process.

To reduce the risk of these types of biases I used what other insider-researchers have described as essential processes of reflexion and reflexivity, in insider-researcher study designs (Geraghty 2018; Irving 2018; Moyo 2018). Reflective practice and reflexivity reduce the risk of bias by improving the trustworthiness of the data collected, which for me, focussed upon keeping reflective diaries and having external conversations (Van Heugten 2004), or what Forrester (2017) described as having "a critical friend". To this end, my primary PhD supervisor and I met and communicated frequently to discuss my insider-researcher approach to data collection and analysis, which offered me an objective critique of my interpretations and findings.

Lastly, research bias may also be present during the analysis phases of studies adopting an insider-research approach. This bias has been described by factors affecting credibility in phenomenological insider-research (Johnson 2016), concerns about study trustworthiness in ethnographic insider-research (Wood 2016) and interlevel dynamics within insider-action research (Coghlan 2019). To this end, I employed both reflexivity as discussed and a proven theoretical framework in the form of NPT so readers could assess the confirmability of the research findings (Kyngäs *et al*. 2020).

Ethics.

In many aspects, factors associated with bias using the insider-researcher approach are also associated with issues directly related to ethical concerns. As such, an ethical application was submitted to the University Of Central Lancashire's research ethics committee before entering the study field and/or capturing any data which included a research protocol to be used to educate participants of the proposed research and indicate the contract for

research participation in March 2013. A second enquiry was also made to the NHS research ethics committee in March 2013 as this research was to take place within an NHS context. However, a full ethics application was deemed unnecessary as this research didn't involve patients directly or would directly affect decisions about patient care as part of the research process.

The university's ethic application sought to determine safeguards necessary to protect both the participants and organizations involved around the subjects of informed consent, social justice, non-maleficence and anonymity (Costley *et al*. 2011). As such, all participants were recruited initially via a formalised MDT teaching session on the purpose of the research, the role of the insider-researcher approach and the ethical issues listed above. Some staff members also had private conversations with me which enabled them to ask personal questions that they may not have felt comfortable asking within the MDT meeting. Insider-research was explained to the staff as a method for creating new beneficial knowledge for both the researcher, academia- and the clinical practice under study, a collaborative approach that encourages participatory types of research (Jervis 2019).

Only when a full explanation had been disclosed, discussed and potential personal issues agreed, did the participants agree to provide informed written consent to participate in the research study. Informed consent included the right to anonymity and withdrawal from the research process up to the point at which the thesis would be submitted. Participation was voluntary Likwise, staff interviews were arranged around the clinicians' chosen time and setting.

Social justice was also a key area of both ethical and bias-risk concerns. In relation to the insider-researcher approach, allowing research participants the freedom to express their beliefs and attitudes about their roles and work structures whilst protecting them from the possible negative consequences of taking part in the planned research (Groot *et al*. 2019). For example, if one staff group had unsavoury things to express about another staff group in relation to OAC practices. Secondly, experiencing and managing bad or potentially poor practice was also foreseen as a potential ethical problem identified during the ethical application process. Here, social justice required an exploration of and planning for a non-blame assessment and explanation to the participants, which thankfully already existed

within the practice culture. The risk of bias associated with social justice lay where the participant and/or I as the insider-researcher wished to under-report or under-represent practices that portray a negative image of the work of particular staff and/or the study centre. This has been described as the notion of "conceal or reveal" which may have affected ongoing clinical practices and integral relationships with the staff including the insider-researcher beyond the period of the research in the context (Anspach & Mizrachi 2006). Here however, social justice concerns about ethic and bias had to be balanced against principles of non-maleficence or doing no harm through unintended criticisms of the practice culture, procedures and beliefs (Costley *et al*. 2011). Secondly. In relation to non-maleficence, there also existed the potential for coercion. This required strategically designed methods to ensure that participants had ownership of their voluntary decisions to participate in the study and to maintain trust throughout the research process (Geraghty 2018).

The possibility of coercion also related to the influence of power on, within and across the practice research participants as there was the potential for a similar perceived unequal power status to exist between the researcher and colleagues in the practice. There was no disguising my identity, and my former and current relationship with staff was an aide to trust and access. Undertaking a formal teaching session on my role as a researcher and fully outlining my aims and objectives, both within a group setting and during one-to-one situations also helped to reinforce my intentions as a researcher. These methods also served to ensure that all those participant colleagues understood exactly what was required of me and of them. Furthermore, undertaking both formal and informal information giving enabled space for staff who may have felt disempowered within formal meetings, to ask questions that may have affected their roles and current relationships. Finally, both of these meeting types with staff, were supported with a formalised university participant contact which outlined the intention of the research, the boundaries for the research, the control and access to data collection and analysis and any future use in publications. Only after a full individualised explanation was given did any of the participants agree to declare their involvements in the study which also included the option to withdraw their participation at any time during the process up to final publication.

Issues around power and coercion also had to be balanced against participant notions of roles and role boundaries for the insider-researcher. The blurring of boundaries between being an insider and researcher has produced challenges in other insider-researcher based studies (Altabaibeh 2017; Moyo 2018). One study of note described role boundary problems specific to staff resistance and seniority complex as some staff were cautious and suspicious about the insider-researcher activity (Moyo 2018).

The blurring of role boundaries also related to other aspects of participant beliefs towards the insider-researcher and it was considered that participant perceptions of the research and/or me as the insider-researcher, may have affected how they agreed to participate in the study and responded during the assessments. Previously, other examples of role blurring in this research context have included the insider-researcher being a staff group advocate, a problem solver with a problem culture, or an educator in a context of education need (Assellin 2003). Therefore, as an insider-researcher, I had to be reflexive about my position within the MDT, not wanting to be seen as promoting any staff group's agenda to enact the OAC change, or resit it, such was the eventual findings from both GPs and nurses. I also didn't want to be viewed as an expert in OAC, even though over time clinically, that is what evolved. However during the data collection period, I needed to also be reflexive of the staffs' attitudes around this concern, as I was interested in exploring their own attitudes and behaviours more than my own, or of them towards me specifically. Furthermore, having a clear research protocol which depicted what I was going to do as an insider-researcher helped to clarify my position within the MDT and reduce the potential for role conflict due to blurred role boundaries (McConnell 2018).

3.4 Methodology.

Formalised methods such as experimentation, or a pure grounded-theory approach, were unlikely to have been applicable to this thesis. The work-based research involved researching the real-life issues in this context, required combining and then developing elements of formal methodologies, to be applied to the research context in question (Costley *et al.* 2011). How and what these methods were will be discussed later, but, for now, it is important to acknowledge the potential impact that the status of insider-researcher had on deciding the methodology, used in this thesis.

A single case-study methodology, which focused on a typical case, and incorporating a mixed-method approach to analyse the more complex and imbedded nature of the case objects, was the most appropriate design to meet the aims of this thesis (Yin 2009).

The rationale for this choosing a single case-study resulted from the nature of the available empirical evidence, which was found to only highlight one aspect of the previously described, stratified reality (Bhasker 1978) within general-practice OAC use. Therefore, other methods previously used in this area haven't been able to explain the complex nature of OAC use in general-practice. Particularly, answering the questions concerning how, why and under what circumstances OAC use prevails in general-practice. This is further explained by Meerabeau (1998, P.35), who stated about tacit knowledge:

> *"…The consensus is that expert performance requires extensive, specific knowledge which takes a long time to acquire but gives access to more power problems solving techniques and practitioner's knowledge is a sprawling and largely untapped resource."*

Furthermore, my own practitioner-researcher status (Reed & Procter 1995) and subsequent ability to engage with the tacit aspects of the general-practice meant that a mixed-methods approach might reveal more detail about the aims within this thesis, rather than using either quantitative or qualitative methods alone.

Initially, an in-depth mapping study (General-practice use of Anticoagulation to Prevent Strokes (GAPS-1)) was designed, to explore and identify the most recent nature of current AF care in this case-study setting. All patients currently on the AF caseload would be mapped against their GP held, medical records, to establish how their condition presented, and was subsequently treated with stroke prevention therapies. This study gave an empirical account of the complexity of AF and OAC management within general-practice, not previously recorded within the academic literature. Furthermore, it facilitated the understanding of the next phase of data collection, which would explore the actions of clinicians in managing OAC in practice (GAPS-2).

GAPS-2 required a theoretical framework to underpin data collection and analysis which was grounded within realist ontology. Designing a realist investigation of a complex

intervention required customization of potentially multiple factors, including CMO-configurations (Jagosh *et al*. 2014). This enabled theory generation depicting how CMO-configurations changed over time (Jagosh *et al*. 2015). Using a theoretical framework to collect and analyse data aimed to build knowledge on previous foundations of knowledge. However, it also encompassed evidence in practice that validated the framework components, and which reduced the researcher bias of value labelling (Procter 1998). Therefore, over two steps, in the second phase of the research, two theoretic frameworks were employed. Firstly, the NPT framework (May *et al.* 2007) was used to structure data collection and immediate analysis of how practitioners organised and embedded the OAC processes to become a practice reality. This then placed the data into a historical context, as it related to the embedding processes, which then enabled analysis using the second CMO theoretical framework (Jagosh *et al*. 2014). Data was examined for aspects of context, which included evidence relating to the interpretation of defined structure (roles/practices/resources/processes). Possible mechanisms, in relation to these contexts, were then categorized under the terms culture, agency and relational factors. Outcomes were finally expressed positively or negatively, in terms of OAC outcomes, which then generated new contexts which would then emerge in the next phase of the NPT assessment. The resultant analysis was then used to construct a logic model, enabling the identification of possible factors required for the creation of a new OAC intervention in general-practice, the basis of which will be discussed next.

OAC use in general-practice has changed, in response to a changing healthcare demand. As a result, this change and subsequent (assumed) implementation requires both means and methods, for implementation and delivery of the required services. Analysis of this means of implementation thus required a theoretical framework, which could be practically applied to this clinical practice research. Numerous theoretical models have been developed to explain innovations in health care, which have collectively been labelled as diffusions of health care innovations (Greenhalgh *et al.* 2004). These include both macro and micro-level theories, which have been deemed to be bounded by constraints of their abilities to focus on whole systems, or too complicated to be useful in practice, and which don't encourage the assessment of the conditions in which interventions can become workable in practice (May 2006). The NPT, however, provided an applied theoretical framework, which enabled

the assessment and analysis of how, and why, complex interventions in healthcare are fashioned and become normalized into everyday practice (May *et al.* 2007). According to May (2006, P.2), normalization is defined as:

> *"…The embedding of a technique, technology or organisational change as a routine and taken-for-granted element of clinical practice."*

Normalization thus includes the implementation, embedding and integration of new practices (May & Finch 2009). Importantly, the NPT comprises three core components, namely actors[5], objects[6] and contexts[7]. The aims of the complex interventions, in relation to these core components, will range from affecting the behavioural change of its actors, altering clinical expertise, and changing clinical systems or goals (May *et al.* 2007). The NPT is further structured around four key concepts (Coherence, Cognitive Participation, Collective Action, and Reflexive Monitoring), all of which represent theoretical constructs of the different types of actions and work, that actors do to enable the embedding of a complex intervention into practice. Furthermore, according to normalizationprocess.org (2019):

> *"…Each construct represents a generative mechanism of social action."*

The four key concepts are constructed from 16 theoretical categories, which are summarised, in Figure 6 (P.86) (May *et al*. 2011). The NPT and subsequent model were, therefore, used to help frame and generate a series of semi-structured clinician interviews that would form the basis for data collection and analysis.

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[5] "*Actors are individuals and groups that encounter each other in health care settings*" (May *et al*, 2007).
[7] "*Objects are the institutionally scanted means by which knowledge and practice are enacted*" (May *et al*, 2007).
[8] "*Contexts are physical, organisational, institutional, and legislative structures that enable and constrain and resource and realize, people and procedures*." (May *et al*, 2007).

Examples of the types of questions that related to the NPT constructs are available in Appendix 12 (P.364). The findings generated from applying the NPT model were then also the foundations for further generative causation analysis, using the realist CMO-configurations discussed earlier. My role as an insider-researcher is acknowledged to have been underpinned by specific motivations from practice and founded upon specific knowledge and understanding of the subject under research that could have affected interpretations about data and theory (Reed & Proctor 1995). Therefore, prompting reflexivity through research supervision was also necessary, to ensure I could develop, confirm and explain Interpretations of theoretical components and findings (Hellawell 2006). Using the NPT framework enabled evidence collected to be verified against the NPT constructs. Thereafter, research supervision facilitated the discussion around both construct and internal validity (Yin 2009). This was also aided by a team supervision approach, which included different academic expertise and perspectives to ensure rigour (Phillips & Pugh 2010).

To summarise, this thesis this was founded upon a realist philosophy, leaning towards an interpretivist perspective, and undertaken from the lens of an insider-researcher, using a case-study approach. The NPT is applied as a framework to structure the analysis in the qualitative element of the thesis, which is finally underpinned by the previous literature review.

The next chapter will therefore describe the first study, where I will present the findings of an investigation into a large general-practice's NVAF caseload, to explore exactly how, and to what extent, the GPs were involved NVAF patient's management. From this point forward, to simplify the writing process, I will refer to NVAF simply as AF, which the reader is reminded, excludes those patients with VAF. As such, I will explore an entire AF patient caseload, mapping their first presentations, which led to AF diagnosis and subsequently, following the patient's journey, to eventual antithrombotic treatment decisions.

Chapter 4.

4.0 (GAPS-1): General-practice use of Anticoagulation to Prevent Stroke: A mapping study.

The previous chapters have highlighted that OAC use in NVAF patients has varied over time, and underuse persists, with failed opportunities to prevent strokes, particularly in female and older patients. The literature review was able to determine OAC rates used in general-practices, and this adds to previous literature, that has examined attitudes to OAC use, which have included general-practice cohorts. The literature review highlighted a lack of evidence about who makes prescribing decisions and how general practices are organized to manage OAC.

The study presented in this chapter represents an original contribution to knowledge by, for the first time, examining through insider-research, how GPs within a single general-practice were involved in the diagnostic, investigative and management phases of all NVAF patients on their caseloads. This knowledge is significant to clinicians' understanding of their historical roles in AF/OAC care. Furthermore, it raises awareness of how general-practice engagements in AF/OAC care might require clinician reassessment.

GAPS-1, therefore, explores and analyzes how NVAF patients were managed in the general-practice setting. Furthermore, it also explored for the first time, how patients presented in general-practice, were diagnosed with AF, and were subsequently managed by their general-practice with stroke prevention measures. The following sections will further describe the methods for this study, including a broad description of the context and background to the study centre. This will be followed by a specific outline of the data collection and extraction methods used.

4.1 Aims: GAPS-1:

1. To analyze AF management within a general-practice setting, explaining the general-practice roles within OAC management.

Objectives: GAPS-1:

1) Describe the practice context and its usual ways of working in relation to AF and OAC use.

2) Explore the journeys of patients who present with symptoms that result in AF diagnosis.

3) Determine when and how general-practice staff are involved in patients' journeys.

4) Examine the antithrombotic rates and impact of general-practice staff involvement in OAC uptake.

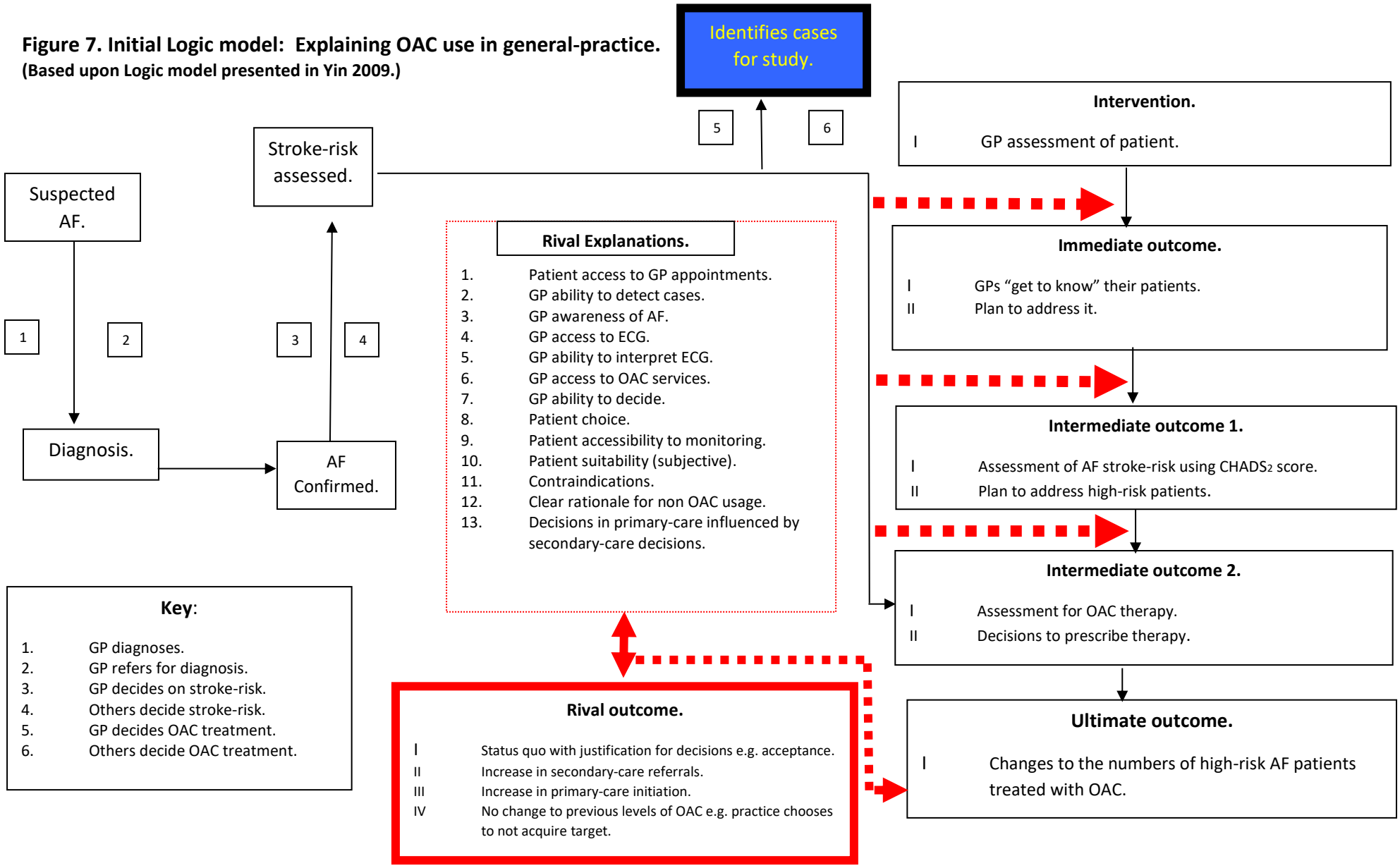
This study is underpinned by a critical-realist philosophy that incorporated a case-study approach, investigated from the lens of an insider-researcher. Therefore, I reiterate here my role as both an insider and researcher, as I undertook the research whilst also employed as the single Nurse Clinician (NC) within the study setting.

The case-study approach allowed for an analysis of a representative and arguably, a revelatory case (Yin, 2009) given the dearth of evidence in relation to this aspect of knowledge uncovered in the literature review. A broad description of the study context is necessary to enable the reader to understand where possible, the practical and cultural aspects of the practice here that may further affect the outcomes of OAC usage to be discussed later. Furthermore, the broad description, underpinned by a logic model of the context, will also serve to ensure that rigor in this study is maintained, through my ability to recount, record and reflect on what I believe, to be important general observations of practice, which may affect my analysis later.

The study centre was a general practice, located in a town situated in north-west England, with a practice population of approximately 14,000 patients, consisting of 1133 (8.02%) patients over the age of 75 years (446 males versus 667 females in 2013) (NHS digital 2013). The practice sat amongst a clinical commissioning group (CCG) that served approximately 125,700 patients (Halton Clinical Commissioning Group 2013 CCG). Within this CCG, there were 17 general practices which comprised 86 individual GPs (NHS digital 2017). The study centre represented the second largest practice within this CCG and consisted of five full-time equivalent GPs, three part-time practice-nurses (PN), a full-time health care assistant (HCA) and my own insider-researcher clinical role, of full-time nurse clinician (NC).

Several important factors, which affected data collection in this study, were informed by the researcher-practitioner's understandings and previous observations of clinical practice. These included, existing practice and OAC systems, clinical data systems, general-practice staff roles (including my own) in repeat prescribing of medications, clinical data collection, and management and how this has changed over time prior to the data collection used in this study. Thus, a preliminary logic model (Figure 7) was constructed of the factors that were assumed to be relevant, based upon this insider-knowledge, and that may allow the reader to judge the data collection approach and subsequent analysis.

Figure 7. Initial Logic model: Explaining OAC use in general-practice.
(Based upon Logic model presented in Yin 2009.)



4.2 Background.

GPs are responsible for a caseload of individual patients' healthcare needs, and their role also includes acting in a gatekeeping capacity to the entire NHS (Kings Fund 2011). Patients therefore require and expect good access to general-practice services. However, patient access to general practice has been reported to be "*in crisis*" with an increase of over 15% in patient contacts between 2011/12 and 2014-15, supplemented by reduced funding and less available GPs (Baird *et al*. 2016). Therefore, delays in investigating and treating conditions, such as AF, are possible. In the study centre, a limited number of advanced appointments were available, so most appointments were booked on the same day. Patients who required appointments had to either call a direct line number after 8.30 each morning or attend the practice when it opened its doors and queue to book one. According to patient feedback, both telephoning and attending for same day appointments with a clinician often require multiple calls. This culminated in many patients reporting negative experiences from long delays and difficulty with access to GP-services.

An external assessment of this practice's systems and patients' responses by the Care Quality Commission (CQC), had also found that patient access to GP appointments was a key area that needed improvement (CQC 2015). However, increasing clinical demands and limited capacity could result in patients frequently reporting long delays in accessing GP appointments. Therefore, access to appointments for patients with new symptoms, or that required follow-up assessments after investigations, could be a barrier. This was of relevance for older patients who are at most risk of AF, and who might also have to rely upon a third party for communication and transport.

4.2.1 Suspecting AF: Obtaining an Electrocardiogram (ECG).

The reasons why patients present to the general-practice and how they come to be diagnosed with AF, were not identified in the literature review. How patients present to the general-practice, which factors prompt general-practice clinicians' consideration of a possible AF diagnosis and by what means clinicians establish a diagnosis, are also unknown. Therefore, an analysis of general-practice initial patient presentations, and general-practice processes was required.

Patients might present at the general-practice asymptomatically and/or with non-specific symptoms suggestive of underlying cardio-respiratory problems. These included symptoms such as chest pains, breathlessness, palpitations, raised blood pressure and irregular pulses, which should prompt clinicians into considering the need for an ECG. External service requirements, such as a new hypertension diagnosis and later life and memory-service referrals, also required ECG recordings. Also, AF is essentially diagnosed using ECG (NICE 2006). Therefore, the GPs were all familiar with the need to use ECGs.

There were two options open to the general practice for obtaining an ECG. The first was to refer externally to the local hospital ECG clinic, and the second was to undertake an ECG in-house. The GPs' use of their own ECG machine had varied uptake because individual GPs had different attitudes towards their skill set about interpreting ECGs. The GPs would therefore commonly refer to an outpatient ECG source which required the GP to complete a hand-written referral template which included the patient's demographic details, medications, and symptoms and declare if they wanted the ECG to be read by a cardio-clinician. This method was simple, but time consuming for both the patient and the GP.

Referrals made by letter template also relied upon the patients contacting the ECG department themselves to arrange and then travel to an appointment which was over 5-6 miles away from the general practice. This, also potentially incurred further barriers for patients, who may have to also rely on public transport. Therefore, in-house ECGs were more convenient for patients especially if they had mobility or social problems that required help from third parties.

However, there were two main benefits for referring externally for an ECG, firstly it did not affect the practice core services by taking up further appointments. In-house practice-nursing appointments were limited, and ECG requests were often fitted in-between routine appointments. This was advantageous when the desire was to capture an ECG immediately following the palpation of an abnormal irregular pulse, particularly if patients presented with new or transient symptoms. However, the practice-nurses were the only staff that used and had access to an individual PC license for the ECG machine and operating software.

The process of recording an ECG involved preparing the specific PC, the ECG module, and patient, downloading the data, printing off the data and then waiting for GP-instructions as

to the results of the ECG. Nurses had no role in ECG interpretation, so had to either wait for the GP which involved having to stand outside the GP's door until the GP was available or, advise the patient to re-book to see the referring GP. Therefore, undertaking an ECG was a time-consuming activity that could also impact the rest of the nurses' appointments.

The second benefit to the GP in referring externally for an ECG was that the ECG would be interpreted by a cardiac physiologist and returned with a report. Furthermore, if an acute problem was detected with a symptomatic patient, then an immediate referral would be made to a cardiology department. The main disadvantage in this system was that it relied on patients making their own appointments and travelling arrangements. Furthermore, delays between referrals and results being communicated, or being made available to the referring GP, were possible. This was also complicated by a lack of formalized patient-recall systems meaning that the system was essentially patient-led.

Therefore, three key potential barriers to OAC use are identified here. Firstly, clinicians must initially consider the need for an ECG on symptoms suggestive of AF. GPs appear to respond satisfactorily in applying guidelines for requesting ECGs in suspected cases using vignettes (Compiet *et al*. 2018), but this was not measured in actual practice conditions. Secondly, there is doubt that clinicians in general-practice, act with competence and feel confident in interpreting ECGs and making an AF diagnosis (Mant *et al*. 2007). Thirdly, patients with AF are, by nature, increasingly older with potential socio-financial restrictions and disabling comorbidities that affect independence and that are independently associated with less OAC use (Bahri *et al.* 2015; Viscogliosi *et al.* 2017). Thus, patient access, to both GP (initial and review) and external ECG appointments, may impede actions towards OAC use.

In summary, the way that patients present at the general practice, how the staff considers that presentation and the potential for AF, together with the methods that are used to investigate AF may all individually, constitute potential barriers to OAC use. However, once an AF diagnosis was made, the GP was then required to make decisions about possible treatment or instructed about treatment started by the hospital.

4.2.2 Initiating OAC and ongoing management.

The literature review in chapter 2 highlighted rates of OAC use in studies located in general practice. However, rates of use were only based upon inferential relationships of chosen study factors. Therefore, the extent, detail and possible barriers of GP-involvement in OAC decisions required clarification here.

If patients were not known to a hospital, once GPs become aware of an AF diagnosis, they then must decide about the need or otherwise for OAC treatment to reduce stroke-risk. This could involve the option to not start OAC at all, and maybe commence APL, or, consider starting OAC. Previously, practicing warfarin initiation, and making decisions to commence warfarin, was viewed as beyond the scope of general practice (Taylor *et al*. 1993). Furthermore, GPs relied upon specialist advice and services for initiating OAC (Lowthian *et al*. 2009).

Consequently, it was also a cultural norm here that GPs would seek advice about the suitability of OAC, or request the initiation of warfarin, via a referral to a cardiologist or to an OAC clinic, based in secondary care. This could negatively impact on patient's costs and quality of life (Jowett *et al*. 2008), which may have also impacted on a GP's decision to initially refer.

Once the hospital OAC clinic commenced OAC with a patient, the hospital clinician would then communicate the intention to continue medications, informing the GP by letter (Appendix 13. P.367). However, no information about ongoing management was ever transferred including compliance and TTIR of individual patients. Henceforth, the GP role was to continue issuing repeat medicines until further notice. Criticisms around the communication of instructions for OAC from secondary care to general practice have persisted (Stafford *et al*. 2011), particularly, as secondary care clinicians often fail to explain the rationale for their OAC decisions to GPs who rely upon their guidance (Bajorek *et al.* 2007). Furthermore, the general practice also had no formalized systems for undertaking OAC medication reviews within the practice. This essentially resulted in blind prescribing and increased the risk of medication errors.

4.2.3 The GP-contract and the QOF.

The GP-contract is the financial agreement which pays GPs for their provision of health services to the UK population which was renegotiated in 2004 with the advent of the QOF. The QOF comprises a series of financial incentives and measures that focus clinical practice and formed the basis for the new GP-contract in 2004. It emerged because of the expansion of evidence-based medicine which demonstrated variations in clinical practice and the possibility of defining quality of care in general-practice (Roland 2011). Renegotiation of the General Medical Council's contract with general practitioners to provide care was thus changed, to include quality incentives that focused upon ten disease groups selected because of the prevalence and effects on burden of disease, whose basis is formed from Read-coding (Roland 2011). These were developed within UK general-practice by Dr James Read in the 1960's as a thesaurus of coded terms and synonyms of everything that may be recorded into the patient's clinical records and were recommended for use nationally in 1988 (Benson 2011). [8] The universal codes allow for pricing authorities to configure and trace payment systems and payments for healthcare services in the UK. They are also commonly used in research programs that use databases; whose data is formed directly for the Read-coding of clinical activities. Databases, such as the general-practice research database, comprise anonymized patient Read-coded data which is supplied through voluntary GP participation via the General-practice Research Database (GPRD) scheme (Medicines and Healthcare products Regulatory Agency and the National Institute for Health Research (NIHR)[9] Hospitals and GPs both rely on Read-coded data which enables payment systems in both environments. Read-codes are generated upon searching for a text-description or word.

In 2006, the GP-contract was due to change, which would result in GPs, for the first time, becoming fully aware of the extent of AF within their practice populations, establishing a

8 "*The motivation was commercial, a point of view shared by other GP suppliers. We recognised that like all computer users, GPs are fundamentally lazy and mildly computer-phobic. We wanted a coding scheme that would allow one-finger typists to enter data in the consulting room, by typing in a few letters and the computer doing the rest. We also sought to commoditise GP computing, so that systems would work straight from the box. In earlier systems, GPs had to develop their own local coding schemes, which deterred prospective customers. We also wanted a system that would be quick to use, so that GPs could use it themselves in the consulting room and could generate reports almost instantly*." (Benson, 2011).

9 https://cprd.com/home.

specialist diagnosis and measuring the extent of antithrombotic therapy (NHS Employers 2006). These initial QOF changes required the formation of an AF registry in each general practice. Previously, the GPs would not have been necessarily aware of the true number of cases of AF within their practice without running purposeful searches. Estimates of the extent of AF had been made based upon prescriptions generated for warfarin and aspirin, but this did not account for use in other possible clinical indications and for patients with AF who were not receiving treatment. The new QOF requirement, based around the concept of Read-codes rather than prescriptions, enforced the need to focus on the clinical AF domain for the first time.

4.2.4 Building the disease registers.

The accuracy and completeness of clinical Read codes used within the electronic patient records has always been concerning (Thiru *et al*. 2003) affecting both primary and secondary care. These result from the variable application of Read-codes during consultations (Jordan *et al*. 2004). In hospital settings, accuracy of Read-coding can be affected by multiple points along the patient's care trajectory and associated paper trail by means of both clinical and administrative errors in assigning Read-codes (O'Malley *et al*. 2005). Furthermore, in this study involving general-practice, difficulties associated with clinical Read-coding may have also led to inaccuracies relating to both AF and stroke-risk for several reasons.

Firstly, external care providers communicated clinical information about patients, usually by paper letter or fax, which also required clinical Read-coding into the patient's electronic records. Read-coding work was undertaken by non-clinical staff, which had to recognize new information that required Read-coding, often complicated, and incorporating acronyms and abbreviations. But also, the coders had to also select the correct Read-code from within a plethora of existing Read-codes available, which were usually dependent upon the requirements of the QOF.

Secondly, and in further relevance to AF mapping, is the accuracy and inclusion of all possible data, that surround the AF diagnosis and associated stroke and bleeding-risk-factors, that could have been used to make decisions about OAC therapy. If information was incorrectly Read-coded or omitted, then this would result in inaccurate stroke-risk burden later.

Thirdly, the QOF requirements in 2006 included scaled payments for the number of summarized historic paper records transferred onto the electronic database (NHS Employers 2006). Thus, at the time of this study, there were outstanding records yet to be Read-coded, which may have resulted in some patients having missing pertinent AF related data.

Fourthly, historic records often contained handwritten summaries of the GP consultations, which were often illegible and containing medical abbreviations, which could be a barrier for a non-clinical Read-coder.

However, a system to encourage clinicians to use relevant Read-codes, that also enabled the QOF requirements during patient consultations, involved the use of templates. Templates were introduced as electronic checklists or prompts, which grew out the need to meet the QOF requirement for the various clinical registers. Templates were designed to enable the clinicians to check boxes both relevant to the QOF field requirements and those relevant to the individual consultation. This method screened out unnecessary available Read-codes, selecting only those relevant to the QOF. However, this also introduced a fifth possible source of Read-coding error. Namely, clinical staff might unintentionally Read-code patients into registers such as stroke or AF, by accidently checking the associated Read-code box within the opened template during a patient consultation. Hence forward, unless noticed, this patient would then falsely become part of the specific disease register.

4.2.5 The use of stroke-risk scoring.

The accuracy and necessity, of adequate Read-coding, was key to how the QOF was organized, and a reflection of meeting clinical care targets. This was demonstrable in a second QOF change in relation to AF patients, as all registered AF patients were required to have a stroke-risk score – the $CHADS_2$ (British Medical Association & NHS Employers 2013) – recorded in their electronic records. The addition of the $CHADS_2$ risk-score onto the AF QOF register was designed to alert GPs to the potential, previously hidden, stroke-risk (British Medical Association & NHS Employers 2013). It was enabled in practice through an electronic alert that appeared when the clinician was in a consultation screen on EMIS - WEB, prompting the clinician, of the need to undertake a $CHADS_2$ measurement. The measurement itself was automatically achieved by clicking the prompt button. The data

necessary for the $CHADS_2$ risk-score was collected and calculated automatically from previously entered clinical Read-codes corresponding to the risk-factors of the $CHADS_2$ risk-score. This prevented the need for clinicians to require searching through electronic records for the components of the $CHADS_2$ risk-score. Alerts of this nature have been shown to increase the odds for OAC use in high, stroke-risk AF patients, both in primary care (Karlsson *et al.* 2018) and secondary care (Piazza *et al.* 2019). However, no such alerts existed then or now for bleeding-risk.

On first introduction to the QOF, there was no requirement to act upon any of the subsequently identified $CHADS_2$ risk-score. It was not until 2012 that identified stroke-risk and OAC use would become part of the QOF, with the OAC treatment targets now established for AF patients with a $CHADS_2$ risk-score greater than 1, taking either, aspirin or OAC. This would again be superseded in 2015 by the introduction of the more refined CHA_2DS_2VASC stroke-risk score (Lip *et al.* 2010) and the percentage of patients treated with a CHA_2DS_2VASC risk-score greater than 1 taking OAC (NHS Employers 2015). At this point, GPs were being incentivized to actively identify their AF populations, measure individual patient's stroke-risk, and ensure that there was adequate stroke-risk-reduction management in place.

4.2.6 Locally enhanced service (LES): Provision of OAC for AF patients.

The final change to affect the general practice here was the introduction and adoption of a locally enhanced service (LES). The LES was developed locally by the commissioning group to incentivize willing general practices to undertake management of stable AF patients who were taking warfarin (Department of Health 2011; NHS Employers 2012; NHS Commissioning Board 2013). A contract of care was negotiated locally, which produced payment for the numbers of INR-tests undertaken in the management of warfarin in AF patients. The service initially funded willing practices, including the purchase of near-patient testing machines, sundries and staff training. The development of this LES and other such LES's were viewed as a practice-development source and one which could improve both patient care and practice incomes. Clinically "*stable*" AF patients taking warfarin were thus slowly recruited over the time, to be managed using a near-patient testing system in-house commencing October 2012.

To summarize, general-practice engagement in AF care - previously undetermined and now incentivized – had been catalyzed by the changes of the evolving QOF requirements. These included the collective identification of AF patients, stroke-risk, and antithrombotic use through the construction of AF practice registers. Furthermore, incentives for general practices, such as OAC locally enhanced services, provided opportunities for service expansion and change to improve the quality of care provide to AF patients taking OAC. Yet, there was a lack of cognizance about how this related to routine general practice. In this background context, the next section will explore how this general-practice managed the patients presenting with first symptoms, to decisions about stroke-risk-reduction. This will comprise an initial analysis of the current AF caseload and include examining historic patient data representing pre-intervention patients[10]. A later and simplified analysis will also be undertaken of any new AF diagnoses that occur after the initial mapping study and will be representative of post-intervention patients.

4.3 Methods.

GAPS-1 is a part of a mixed-methods, insider-researcher case-study, examining one general-practice, who adopted the locally enhanced service level 4 management of OAC.

Setting: A single general-practice in the North-West of England with 5 full time GPs, 3 part-time practice-nurses, a full-time healthcare assistant. Furthermore, I act as both full-time nurse clinician and insider-researcher. Practice population of 14,134 patients.

Ethical approval was granted by the University ethics committee, (BuSH Ethics Committee Reference Number: BuSH 106, 08/03/2013) NRES was not required.
The two objectives underpinning this study aim, aided in defining what this mapping study is, and how it differs from other technical definitions of mapping studies.

Rationale.

The first objective was to explore the patient's journey throughout the diagnostic processes that are available to patients in primary and secondary care. The current literature makes no

10 Interventions included the changes to the QOF-AF criteria and the OACLES.

reference to the ways in which patients present with symptoms and are subsequently diagnosed with AF. Furthermore, the literature also fails to discuss any possible association between how patients present and the observed outcomes of OAC uptake, in relation to general practice.

The second objective was to determine, when and how, GPs and nurses are actively involved in the patient's journey, from diagnosis of AF, through to OAC treatment decisions. Here, I further assert, that the roles undertaken within general practice in relation to the reported OAC uptake rates remains unclear. Previous papers published in relation to GP practice and OAC uptake often rely upon repeat prescribing data. Prescription data alone does not ascribe OAC decision-making responsibility to the GP beyond that of repeat prescribing. Therefore, there may be aspects of the GP roles within these processes that positively or negatively affect OAC uptake beyond what is known from the previous literature review chapter. These will be presented as case examples.

Thus, next I map actual general-practice influences within the patient's journey by identifying the points at which the general-practice roles became active. I further map the nature (positive or negative) of the OAC outcome in terms of OAC uptake.

4.3.1 Defining Mapping.

I hypothesized that the level of involvement of general practice in OAC therapy might be over or under-represented in previous studies. To investigate this, I needed to collect data different from other studies related to OAC use. This included focused mapping data based around Read-coded and free text entries of NVAF patients in general-practice records. There were no specific methods found within the literature explaining how to map general-practice Read-coded data to actual general practice activity. Therefore, I had to devise a method to undertake the aim of this chapter which involved mirroring methods used in other fields.

Many definitions of mapping have been used to describe study methods, but in health care research, I found that the most compatible definition related to that used to map the experience of dementia patients (Bradford Dementia Group 2005). Dementia care-mapping was developed to enable a patient-centered approach to the assessment and planning of

care (Bradford Dementia Group 2005). Patients are observed and assessed continuously throughout a period, and their care needs, with behaviors, are recorded, to develop a personal action plan for nurses to enable suitable care.

Applying dementia mapping to AF patients.

AF and dementia are clearly different in their physical causes, patient needs, and resulting patient outcomes. However, applying the principles of patient-centered mapping to explore how a patient with AF experiences the diagnostic and management steps, enabled investigation into individualized patient experience of the AF management systems that were available to them. Using the same method as the dementia care mapping process would require patients with AF to be mapped prospectively. This method of mapping was deemed not suitable for this case-study as it would only enable the investigation of about 20 patients per year based upon observed trends for new AF diagnoses within this research setting. Furthermore, identifying patients at the beginning of their presentation which lead to AF diagnosis would not be practical, as this study was not designed to screen patients for AF. Instead, a retrospective mapping process could be useful and feasible, using clinical documentation to enable analysis of how, where and when patients encountered health services, particularly general practice, in relation to their AF presentation and ongoing management. Therefore, this mapping study was based upon a patient-centered approach applied in dementia-assessment mapping, using it retrospectively, to analyse data collected via clinical documentations, and not through direct patient observations (Table 17).

Table 17. Patient-centred mapping.

AF Mapping.	**Dementia Mapping.**
Indirect patient observations.	Direct patient observations.
Retrospective approach.	Prospective approach.
Maps patient journey.	Maps patient experience and resulting behaviours.
Identifies key clinical moments, staff and decision steps.	Identifies patient-specific care needs.

Each point along the patient's journey would include processes involving general-practice, which were critical for decisions, which culminated in stroke-risk assessment. Therefore, to understand the current general-practice roles in OAC use, it was important to highlight

these pathways and processes to the reader. The method for undertaking this is described next.

A comprehensive search of the GP-electronic medical-records database EMIS-WEB (Egon Medical Information Systems Limited 2014) using Read-codes was instigated, which enabled an examination of the timing of initial symptoms, presentation, investigations, diagnosis, and treatment-decision steps. Eleven of the 17 clinical disease group registers were potentially relevant to the diagnosis of AF and were thus searched (Table 18). EMIS WEB (Egton Medical Information Systems Limited 2014) also has a search-term function which allows for specific words and Read-codes to be searched without entering the entire patient record.

Table 18. Practice registers and Read-codes searched.

Electronic Registers searched.
Atrial fibrillation; CHD; Stroke; Hypertension; Peripheral artery disease; Diabetes; Heart failure; COPD; Cancer; Chronic kidney disease.
Individual search terms.
$CHADS_2$; Bleeding; Transient ischemic attack; CHA_2DS_2VASC; Atrial fibrillation resolved; HASBLED; Hypercholesterolemia; Liver function; Renal function; Prescription history; Anaemia; Alcohol; Warfarin; Dabigatran; Warfarin; Anticoa…. lant /lation/s; Aspirin; Rivaroxaban; Warfarin refused/declined/contraindicated; Acenocoumarin; Apixaban; Phenindione; Enoxaparin.

A stepwise approach was taken to searching the electronic patient record (Figure 8). Firstly, the AF population was identified using the practice registers and searching for any evidence of AF in the electronic record, irrespective of treatment status, and then, anonymized for data extraction. Each patient was given a study number and the AF Read-codes that were used were searched. Once the date of the initial Read-code was identified (Read-code G573), the date could be used to identify attachments of correspondence that corresponded to investigation and referrals. This allowed analysis of the timing around patient's presentation, investigations, referrals and treatment decisions, to be recorded. The correspondence analysis also enabled an assessment of the general-practice approach to AF management beyond just the timeline of events. For example, identifying key words or phraseology used in the correspondence could also help map the general-practice

management intentions. The next step was to perform the detailed review of information, including attachments and free text entries linked to the Read-coded data using the search-term function (Figure 8, individual search terms). These terms were searched to identify possible reasons for contraindications and reasons why OAC may have been delayed, not commenced, or discontinued.

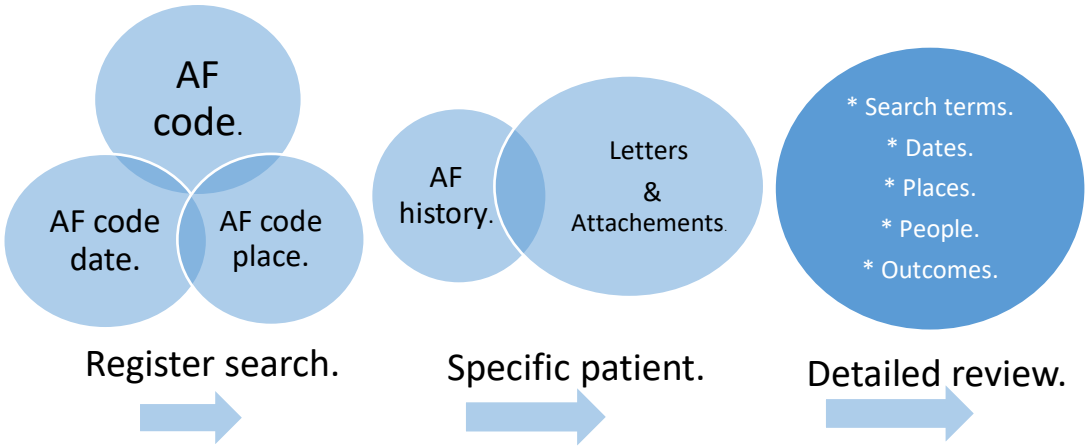


Figure 8. Individual patient search process.

4.3.2 Data extraction.

Data extraction sheets were piloted with 20 patient records to demonstrate usability and to ensure completeness of relevant fields of data extraction (Appendix 14, P.368). The pilot phase resulted in new data coding fields on the data extraction forms relating to potential patient pathways. In practice, each patient's record was identified, with dates collated onto a spreadsheet for each event. This would start from the first recognized symptom or reason for presentation and be followed by what happened next in terms of referral, investigation and/or treatment decisions. The initial code would be assigned to the mapping route, and would be dependent upon where this process started, and these included the GP, accident and emergency, outpatients, wards and walk-in centres. For example, the code GP1 would be assigned to cases who had initially attended to see their general-practice clinicians with symptoms, and then have an ECG in-house, to which the clinicians were able to make an AF diagnosis, and then decide upon treatment. It was anticipated that many such variations might emerge. As such, it would be later necessary to group these into urgent and non-urgent categories.

The inclusion of key phrases from letter correspondence around specific dates, such as referral and AF diagnosis, were an additional category for data extraction determined by the piloting stage. There were cases identified in the pilot stage that did not easily convey the pathway of the patient's journey from Read-codes alone. This may have been because of the nature of the Read-coding process on hospital letter correspondence. Therefore, a closer analysis of the letters was required, which avoided identification of individual general-practice patterns, thus risking GP identification. Furthermore, in consideration of the possible mechanisms relating to OAC practice, amendments to the data extraction tables were also made, focusing on two key factors.

Firstly, there were aspects of phraseology from both the GPs and communicating clinicians that either asked questions of, infer about, or instruct the other regards OAC management. For example, hospital clinicians wrote in their communications to the GPs things like,

"…*I recommend the use of*" or "…*The patient has been commenced upon*"

These instructions were often expressed without the mention of a risk-analysis from which those decisions were based. This phraseology was therefore considered to be important evidence in explaining the OAC patient outcomes.

Secondly, there were also early examples relating to referral rationales within the letter correspondences, which might expand explanations about OAC use, from using clinical Read-codes alone. For example, there were occurrences of GPs recognising AF as a reason to refer to cardiology with written explanation for the interim use of APL. This might suggest that the GPs had examined individual patients and made the decision to consider commencing OAC. However, it also might infer that this responsibility should lie with the cardiologist, and not the GP. Motivations for referrals and subsequent instructions, and or guidance, were thus deemed important factors to collate, to enable explanation of the patterns of OAC use later. Overall, the data fields chosen were underpinned by the study objectives.

4.4 Analysis.

The analysis of data is separated into two sections. Section A) An analysis of initial mapping, which included the existing AF caseload, and was undertaken between, June 2013 and

October 2013 and examined all AF patient data including patient initial presentation, general-practice contacts and overall antithrombotic decisions. Section B) included only new AF patients, who were diagnosed between November 2013 and February 2017, and only focused upon patients who had GP practice contact. Baseline characteristics and OAC use are reported, in relation to both patient age when screened, if over or under 75 years, and gender, because of the potential importance of these characteristics. Age is of importance, as age greater than 75 years is now considered itself to be a reason for OAC treatment, without other risk-factors (NICE 2006, 2014).

Statistical analysis was performed using SPSS statistics V.25 (IBM 2017). Descriptive statistics (mean [SD] or n [%], as appropriate) were used for baseline characteristics, both overall and within groups. Continuous variables such as age were compared between groups using the *t*-test, with degrees of freedom (*df*) and *p*-value, with $p < 0.05$ deemed statistically significant. However, a Mann-Whitney *U*-test was used when there appeared to be skewed distribution within time-recorded data, with a 2-tailed $p < 0.05$ also denoting statistical significance. Other categorical variables, such patient-comorbidity, potential contraindications to OAC, and antithrombotic treatments were compared between gender, and age under 75 versus over 75 years using chi-square (χ^2) tests. If the numbers were very small (expected values <5), then Fisher's exact test was employed with odds ratio estimates reported, incorporating 95% confidence intervals.

4.5 Results.

Initial mapping of the GP-practice population was undertaken (A) and identified a total of 297 patients, with a recorded Read-code of AF. The secondary mapping (B), identified a further 56 new patients with AF. Ten different members of practice staff had contact with patients regarding the management of their OAC therapy. These included five GPs, who had been qualified for a median of 21.8 years (range: 5-33 years); three registered general nurses; one HCA and one nurse clinician.

4.5.1 Baseline patient characteristics.

There was a practice population of 14,134, and AF was Read-coded in 297 patients (2% prevalence rate). Out of 297 patients, 54.2% were male and 45.8% were female. A *t*-test showed that on average, females (mean 76.7, SD 10.71 years), were significantly older than males (mean 72.1, SD 10.71, $t = -3.6$, $df = 295$, $p = 0.001$).

Comorbidities were also collected from within the patient's records, which when compared to gender, were mostly not statistically significantly different (Table 19). For example, it was found that hypertension was the most common comorbidity Read-coded in 181/297 (60.9%) of the AF caseload. The difference in the percentages of females (66.9%) who were hypertensive, compared to males was marginally non-significant (56.0%) (OR: 1.61, 95%CI, 0.99 to 2.56, $p = 0.053$). There were no significant differences between the percentages of males (12.4%) and females 15.4%) who had suffered a stroke, or who had experienced myocardial infarction (male 24.2% versus female 16.2%) (Table 19).

The low prevalence of some of the factors identified, limited the power to detect meaningful statistical differences. Conversely, there were four co-morbid factors showing significance differences between the genders. Three of these factors affected women more than men. These included patients Read-coded with "*falls*", "*anaemia*", "*chronic kidney disease*" (CKD), and "*alcohol use*", all of which were considered as potential contraindications in the previous literature review, and "*thyroid disease*" which is associated with AF (Table 20).

Firstly, there were 49 patients with a falling Read-code (16.5% of all AF). Analysis showed that there was a significant association between gender and falling, with over twice the percentage of females (22.8%) with AF falling than men (11.2%; $\chi^2 = 7.22$, $df = 1$, $p = 0.007$, OR: 2.35, 95%CI: 1.25 to 4.42). Secondly, with anaemia, 44 cases were identified amongst the AF cohort (14.81% AF prevalence), and analysis showed that there was a significant association between gender and anaemia, with over twice the percent of females (21.3%) with AF and anaemia, as males (9.3%; $\chi^2 = 8.42$, $df = 1$, $p = 0.0004$, OR: 2.64, 95%CI: 1.35 to 5.20). Thirdly, a significant association was also found between gender and CKD, with 33.1% of females and 21.7% of males Read-coded with CKD. Thus, out of 80 cases with AF, females

were over 1.5 times more likely to have CKD and AF (χ^2 = 4.83, *df* = 1, *p* = 0.03, OR: 1.78, 95%CI: 1.06 to 2.99).

Conversely, out of 33 cases (11.1% prevelance), there was also a significant associaion between gender and Read-coded excessive alcohol use with AF, with 16.8% of males, compared to only 4.4% of females, having a Read-code for excessive alcohol use recorded (χ^2 = 11.40, *df* = 1, *p* = 0.001, OR: 0.23, 95% CI: 0.09 to 0.57).

Finally, out of 35 documented cases (11.78% AF prevalence), there was also a significant association between gender and thyroid disease and AF, with 19.1% of females, compared to 5.6% of males, having thyroid disease recorded (χ^2 = 12.98, *df* = 1, *p* = 0.0003, OR: 3.99, 95% CI: 1.80 to 8.85).

Stroke-risk calculations using both the $CHADS_2$ and CHA_2DS_2VASC risk-scores were undertaken in retrospect, for all AF patients on the AF caseload (Table 23). There was no significant difference between males and females, at high-risk of stroke, using either criteria. As expected, overall fewer patients were scored at high-risk using the $CHADS_2$ risk-score (71.70%) versus CHA_2DS_2VASC risk-score (95.62%). Bleeding-risk scoring was limited, and only recorded in 35% of AF cases, which reflected the AF caseload managed in-house, taking warfarin.

AF patients aged below, and over 75 years, were also compared at baseline for common comorbidities and potential CIS. However, of the common comorbidities, only patients with a history of "*any cancer*" (χ^2 = 8.10, *d*f = 1, *p* = 0.004, OR: 2.71, 95%CI: 1.34 to 5.48), "*cardiac failure*" (χ^2 = 4.78, *df* = 1, *p* = 0.03, OR: 1.79, 95%CI: 1.12 to 3.04) and "TIA" (χ^2 = 4.45, *df* = 1, *p* = 0.04, OR: 2.44, 95%CI: 1.04 to 5.69), were significantly associated with age-group, with higher prevalence amongst those aged 75 years or above (Table 22). Similarly, most potential contraindications were also more likely to exist in AF patients over the age of 75 years. These included, the presence of "*anaemia*" (χ^2 = 4.26, *df* = 1, *p* = 0.04, OR: 2.03, 95%CI: 1.03 to 4.00), "*chronic kidney disease*" (χ^2 = 17.41, *df* = 1, *p* = 0.00003, OR: 3.23, 95%CI: 1.83 to 5.68), "falls" (χ^2 = 18.20, *df* = 1, *p* = 0.00002, OR: 4.74, 95%CI: 2.21 to 10.19), "*lacks capacity*" (χ^2 = 8.08, *df* = 1, *p* = 0.004, OR: 11.03 , 95%CI: 1.42 to 85.94) and "*social reasons*" (χ^2 = 19.95, *df* = 1, *p* = 0.00008, OR: 5.79, 95%CI: 2.49 to 13.44), which were found

to be significantly associated with AF patients aged greater than 75 years (Table 22). Conversely, only "*alcohol use*" (χ^2 = 19.03, *df* = 1, *p* = 0.00001, OR: 0.16, 95%CI: 0.06 to 0.40) and "*liver disease*" (χ^2 = 4.20, *df* = 1, *p* = 0.04, OR: 0.27, 95%CI: 0.72 to 1.03), revealed significantly lower prevalence amongst AF patients under the age of 75 years (Table 23).

In relation to the earlier objectives 1 and 4, this baseline data shows that there were several patient characteristics that might have affected either past or current decision making surrounding OAC. For example, females seem to have been observed as having significantly more key stroke and bleeding-risk co-morbidity than males. Although, this is not reflected in the data reflecting risk calculations. However, the baseline characteristics also do not help understand who, where and when OAC decisions have/are being made, and are the outcomes which I turn to next.

Table 19. Baseline general comorbidity characteristics comparing gender.

Factor.	Total.	Males.		Females.		χ^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	(%)	n	(%)				
Any cancer.	45 (15.2)	22	13.7	23	16.9	0.61	0.44	1.29	0.68 to 2.43
Cardiac failure.	81 (27.3)	46	28.6	35	25.3	0.31	0.59	0.87	0.52 to 1.43
COPD.	26 (8.7)	16	9.9	10	7.4	0.62	0.43	0.72	0.32 to 1.64
Diabetes.	84 (28.3)	48	29.8	36	26.5	0.40	0.52	0.85	0.51 to 1.40
Falls.	49 (16.5)	18	11.2	31	22.8	7.22	0.007	2.35	1.25 to 4.42
Hypercholesterolemia.	33 (11.1)	21	13.0	12	8.8	1.33	0.25	0.65	0.31 to 1.37
Hypertension.	181 (60.9)	90	55.9	91	66.9	3.76	0.05	1.61	0.99 to 2.56
Myocardial infarction.	61 (20.5)	39	24.2	22	16.2	2.93	0.09	0.60	0.34 to 1.08
Peripheral artery disease.	24 (8.1)	12	7.5	12	8.8	0.19	0.67	1.20	0.52 to 2.77
Stroke.	41 (13.8)	20	12.4	21	15.4	0.57	0.45	1.29	0.67 to 2.49
Thyroid.	35 (11.8)	9	5.6	26	19.1	12.98	0.0003	3.99	1.80 to 8.86
TIA.	29 (9.8)	13	8.1	16	11.8	1.14	0.29	1.52	0.70 to 3.28
Valve disease.	37 (12.5)	19	11.8	18	13.2	0.14	0.71	1.14	0.57 to 2.27
Venous thrombus embolism.	16 (5.5	10	6.2	6	4.4	0.47	0.49	0.71	0.25 to 1.97

Degrees of freedom *(df)* = 1 for all tests.

Table 20. Baseline contraindication characteristics comparing gender.

Factor.	Total.	Males.		Females.		X^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	%	n	%				
No CIS.	222 (74.7)	125	77.6	97	71.3	1.56	0.21	0.72	0.42 to 1.21
Alcohol use.	27 (9.1)	6	16.8	33	4.4	11.40	0.001	0.23	0.09 to 0.57
Allergy to warfarin.	3 (1.0)	1	0.6	2	1.5	0.53	0.47	2.39	0.21 to 26.63
Anaemia.	44 (14.8)	15	9.3	29	21.3	8.42	0.0004	2.64	1.35 to 5.16
Any recorded CIS.	69 (23.2)	32	19.9	37	27.2	2.22	0.14	1.51	0.88 to 2.59
Chronic kidney disease.	80 (26.9)	35	21.7	45	33.1	4.85	0.03	1.78	1.06 to 2.99
GI bleeding.	62 (20.9)	38	23.8	24	17.8	1.57	0.21	0.69	0.39 to 1.23
Hypertension.	6 (2.0)	1	0.6	5	3.7	3.48	0.06	6.11	0.71 to 52.92
Labile INRs.	8 (2.7)	3	1.9	5	3.7	0.98	0.34	2.01	0.47 to 8.57
Lacks capacity.	13 (4.4)	5	3.1	8	5.9	1.36	0.24	1.95	0.62 to 6.11
Liver disease.	12 (4.0)	5	3.1	7	5.1	0.79	0.37	1.69	0.53 to 5.46
OAC not indicated.	33 (11.1)	18	11.2	15	11.0	0.002	0.97	0.99	0.48 to 2.04
Pro-bleeding drugs.	74 (24.9)	40	24.8	34	25.0	0.001	0.98	1.01	0.59 to 1.71
Social reasons.	45 (15.1)	19	6.4	34	8.8	3.07	0.08	1.77	0.93 to 3.36
Three or more drugs.	220 (70.1)	112	69.6	108	79.4	3.71	0.05	1.69	0.99 to 2.88

Degrees of freedom *(df)* = 1 for all tests.

Table 21. Baseline characteristics of stroke and bleeding-risk comparing gender.

Factor.	**Total.**	**Males.**		**Females.**		X^2	***p* value.**	**OR.**	**95% CI for OR.**
	n (%)	n	%	n	%				
$CHADS_2$ = high-risk.	100	108	67.1	105	77.2	3.73	0.05	1.66	1.00 to 2.79
CHA_2DS_2VASC equals 1 and not females or more.	100	155	96.3	129	94.8	0.36	0.55	0.71	0.23 to 2.18
HASBLED ever.	111 (34.02)	66	39.1	41	30.2	2.62	0.11	0.67	0.41 to 1.11

Degrees of freedom *(df)* = 1 for all tests.

4.5.2 Antithrombotic use at baseline mapping.

Point prevalence of antithrombotic use was also collated for the different drug choices, and findings suggested that there was no significant association between individual drug groups used and AF patients' gender (Table 25). Out of 297 patients, 154 (51.8%) were currently taking any OAC (95%CI: 46.2% to 57.5%). However, there was no significant association between gender and current OAC use, with 50.7% of females and 53.8% of males, taking any OAC (OR: 0.92, 95% CI: 0.58 to 1.45, p = 0.72) (Table 25).

Secondly, most OAC use consisted of warfarin treatment. Overall, 146 patients were taking warfarin, yet there was again, no significant association between gender and warfarin use, with 46.3% of females, and 51.5% of males, taking warfarin (OR: 0.81, 95%CI: 0.51 to 1.28, p = 0.70).

Finally, point prevalence of antithrombotic use, was also collated for the different drug choices, and the findings suggested that there was no significant association between individual drug groups used and AF patients' ages (under versus greater than 75 years, Table 24).

The next section develops the examination of how the general-practice managed patients presenting with symptoms that led to an AF diagnosis, what investigatory processes the GPs were engaged with, and how the general-practice interventions resulted in antithrombotic decisions with patients.

4.5.3 How do patients present who are diagnosed with AF?

An examination of where patients first presented included 272 patients with data (91.5%, 272/297), and the reasons for their presentations which led to a warfarin treatment decision, revealed 60 different patient pathways (Appendix 15, P.329). These pathways included the general-practice, Accident and Emergency Department (AED); Out-Patient Department (OPD); wards and walk-in clinics. This represented a complex array of possible patient-journeys that might affect the outcome of OAC decision-making. However, to highlight the general-practice's involvement, the 60 pathways were refined into 7 mutually exclusive groups, representing the known pathways of the AF caseload (Table 26).

Table 22. Baseline comorbidity characteristics comparing age groups.

Factor.	Total.	Patients under 75 years.		Patients over 75 years.		X^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	(%)	n	(%)				
Any cancer.	45 (15.1)	12	8.8	33	20.6	8.10	0.004	2.71	1.34 to 5.48
Cardiac failure.	81 (27.3)	29	21.2	52	32.5	4.78	0.03	1.79	1.12 to 3.04
COPD.	26 (8.7)	10	7.3	16	10.0	0.67	0.41	1.41	0.62 to 3.22
Diabetes.	84 (28.3)	45	32.8	39	24.4	2.61	0.11	0.66	0.40 to 1.09
Hypercholesterolemia.	33 (11.1)	13	9.5	20	12.5	0.68	0.41	1.36	0.65 to 2.85
Hypertension.	181 (60.9)	81	59.1	100	62.5	0.35	0.55	1.15	0.72 to 1.84
Myocardial infarction.	61 (20.5)	23	16.8	38	23.8	2.21	0.14	1.54	0.87 to 2.75
Peripheral artery disease.	24 (8.1)	12	8.8	12	7.5	0.16	0.69	0.85	0.37 to 1.95
Stroke.	41 (13.8)	16	11.7	25	15.6	0.97	0.33	1.40	0.71 to 2.75
Thyroid.	35 (11.8)	11	8.0	24	15.0	3.50	0.06	2.02	0.95 to 4.30
TIA.	29 (9.7)	8	5.8	21	13.1	4.45	0.04	2.44	1.04 to 5.69
Valve disease.	37 (12.5)	18	13.1	19	11.9	0.12	0.74	0.89	0.45 to 1.78
Venous thrombus embolism.	16 (5.4)	6	4.4	10	6.3	0.51	0.50	1.46	0.52 to 4.11

Degrees of freedom *(df)* = 1 for all percentages.

Table 23. Baseline contraindication characteristics comparing age groups.

Factor.	Total cases.	Patients under 75 years.		Patients over 75 years.		X^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	(%)	n	(%)				
No CIS	222 (74.7)	101	73.7	121	75.6	0.14	0.71	1.12	0.66 to 1.87
Alcohol use.	27 (9.1)	27	19.7	6	3.8	19.03	0.00001	0.16	0.06 to 0.40
Allergy to warfarin.	3 (1.0)	1	0.7	2	1.3	0.20	0.66	1.72	0.15 to 19.20
Anaemia.	44 (14.8)	14	10.2	30	18.8	4.26	0.04	2.03	1.03 to 4.00
Any recorded CIS	69 (23.2)	19	13.9	30	18.8	1.28	0.26	1.43	0.77 to 2.68
Chronic kidney disease.	80 (26.9)	21	15.3	59	36.9	17.41	0.00003	3.23	1.83 to 5.68
Falls.	49 (16.5)	9	6.6	40	25.0	18.20	0.00002	4.74	2.21 to 10.19
GI bleeding.	62 (20.9)	27	20.0	35	21.9	0.16	0.69	1.12	0.64 to 1.97
Hypertension.	6 (2.0)	2	1.5	4	2.5	0.40	0.53	1.71	0.31 to 9.60
Labile INRs.	8 (2.7	2	1.5	6	3.8	1.48	0.22	2.63	0.52 to 13.25
Lacks capacity.	13 (4.4)	1	0.7	12	7.5	8.08	0.004	11.03	1.42 to 85.94
Liver disease.	12 (4.0)	9	6.6	3	1.9	4.20	0.04	0.27	0.07 to 1.03
OAC not indicated.	33 (11.1)	20	14.6	13	8.1	3.12	0.08	0.52	0.25 to 1.08
Pro-bleeding drugs.	74 (24.9)	35	25.5	39	24.4	0.05	0.82	0.94	0.56 to 1.59
Social reasons.	45 (15.1)	7	5.1	38	23.8	19.95	0.00008	5.79	2.49 to 13.44
Three or more drugs.	220 (70.1)	95	69.3	125	78.1	2.96	0.09	1.58	0.94 to 2.66

Degrees of freedom *(df)* = 1 for all percentages.

Table 24. Antithrombotic use comparing age groups.

Factor.	Total cases.	Patients under 75 years.		Patients over 75 years.		X^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	(%)	n	(%)				
Warfarin ever.	198 (66.7)	93	67.9	105	65.6	0.17	0.68	0.90	0.56 to 1.47
Currently using any OAC.	154 (51.8)	74	54.0	80	50.0	4.77	0.49	0.85	0.54 to 1.35
Currently using warfarin.	146 (49.2)	69	50.4	77	48.1	0.15	0.70	0.91	0.58 to 1.44
Currently using Aspirin.	114 (38.4)	45	32.8	69	43.1	3.30	0.07	1.56	0.97 to 2.49

Degrees of freedom *(df)* = 1 for all percentages.

Table 25. Antithrombotic use comparing gender.

Factor.	Total.	Males.		Females.		X^2	*p* value.	OR.	95% CI for OR.
	n (%)	n	%	n	%				
OAC ever.	198 (66.7)	113	70.2	85	62.5	1.96	0.16	0.71	0.44 to 1.15
Currently using any OAC.	154 (51.8)	85	53.8	69	50.7	0.13	0.72	0.92	0.58 to 1.45
Currently using Warfarin.	146 (49.2)	83	51.5	63	46.3	0.81	0.41	0.81	0.51 to 1.28
Currently using Aspirin.	114 (38.4)	61	37.9	53	39.0	0.04	0.85	1.05	0.65 to 1.67

Degrees of freedom *(df)* = 1 for all tests.

Three of these mutually exclusive groups were GP pathway groups: the pathway, "*GP-non-urgent*", represented cases that did not require same day assessment in a hospital setting. Whereas, the "*GP-non-urgent-urgent*" pathway and cases, became urgent, after attending for routine investigations, arranged by the GP; the "*GP-urgent*" cases were those that the GP referred for assessment, usually to a hospital on the same day. The "*GP-non-urgent*" groups of pathways were the most common and which accounted for 36.4% of all patients' journeys. Furthermore, of all patient initial presentations, the general-practice was the also first point-of-contact in over 57.7% (157/272) of all AF cases. Finally, eight unique GP pathways (grouped as "*GP-urgent*") accounted for 16.9% of all patient journeys. These pathways included urgent referrals where decisions about OAC were taken in a hospital setting. These results highlight the importance of the general-practice roles along the patient's journey, from diagnosis to treatment decisions, which may have been under-appreciated by previous research into understanding the nature of OAC rates.

Table 26. Patient presenting pathways.

Patient pathway.	**Frequency, of patients on pathway (known) Total patients with data, n=272.**	**(%) of patients on pathway.**
GP pathways.		
GP-urgent.	46	16.9
GP non-urgent.	99	36.4
GP non-urgent becomes urgent.	12	4.4
Total of patients on GP pathways.	157	57.7
Non-GP pathways.		
AED.	65	23.9
Ward.	12	4.4
OPD.	36	13.2
Walk-in centre.	2	0.7
Total patients on Non-GP pathways.	115	42.3
Missing data = 25/297 (8.5%).		

Presenting reasons and symptoms.

After excluding patients with missing data (n=23), it was found that most patients had a reason or symptoms listed during the initial presentation in their patient records (200/274, 73.1%). Patients presented individually, with a range of twenty different, singular or multiple symptoms (Table 27), with breathing difficulty being the most common first presenting symptom (47/274, 17.1%). Several patients with data had no symptoms recorded, who were attending for routine reviews (7/274, 2.6%). An example of

asymptomatic patient presentation was Patient #2 (Figure 9). This involved a patient attending for a flu vaccination. During this consultation, the general-practice clinicians were prompted by way of electronic alert, to undertake an overdue blood pressure check.

Figure 9. Patient #2. GP case-finding during flu-jab attendance.

Day 1: Mid 2010 Attended GP for flu jab, routine pulse check found to have irregular pulse. ECG in-house reported AF was referred routinely to cardiology. was kept on Aspirin.
Day 20: Seen in clinic, Cardiology wanted to start warfarin as OPD.
Day 34: Warfarin commenced in OAC clinic.

The opportunistic procedure led to the GP finding that the patient had an irregular pulse, and so began the process of GP-investigations and referral. This process would eventually lead to warfarin commencement. Case-finding during flu-jab attendances were examples of care that highlighted the importance of opportunistic pulse screening in general-practice. Of the patients who presented via a GP pathway, 68.8% (108/157) had symptoms.

Table 27. First presenting reasons/symptoms.

Presentation reason/symptom.	Number of patients with symptom. (%) AF caseload affected.
AF Risk-factors. [11]	
Blood pressure review (hypertension, diabetes reviews).	7 (2.6)
Cardiology review (including heart failure).	11 (4.0)
During surgery.	2 (0.7)
Post-operative.	14 (5.1)
AF symptoms.	
Blackout: dizziness, Light-headedness.	16 (5.8)
Breathing difficulty.	47 (17.1)
Acute chest pain.	27 (9.8)
Acute collapse; confusion; cardiac arrest; acute unwell.	19 (6.9)
Acute stroke/TIA.	9 (3.3)
Ankle swelling.	10 (3.6)
Cough, pneumonia.	22 (8.0)
Palpitation.	25 (9.1)
UTI.	4 (1.5)
Other.	
Read-Codes only.	14 (5.1)
? DVT; calf pain; cellulitis.	3 (1.1)
GI symptoms.	5 (1.8)
Minor illness.	10 (3.6)
Other: includes alcohol; allergic reaction; loin pain; falls.	16 (5.8)
Pre-operative.	6 (2.2)
Routine GP check other.	7 (2.6)
Total.	274 (100)

4.5.4 AF patient referrals.

Assessment of the various individual patient pathways also revealed general-practice referral activity (Table 28). GPs would either make direct patient referrals, or, refer on the request of other clinicians, without direct patient contact. For example, a cardiologist might request that the GP initiate warfarin, which required a GP referral to OAC clinic. Thus, the

11 As suggested by Hear Rhythm Society, 2019. https://www.hrsonline.org/Patient-Resources/Heart-Diseases-Disorders/Atrial-Fibrillation-AFib/Symptoms-of-AFib.

GPs were involved in a total of 264 referrals, including 43/264 (16.3%) patients referred to AED unwell with symptoms, as well as 93/264 (35.2%) non-urgent cardiologist referrals. In over half of these referrals (57/93), the GP specifically enquired about the need for warfarin use (61% of all GP-Cardiologist referrals).

Table 28. GP referrals.

GP referred to:	Frequency.	%.
ECG outpatient.	98	37.1
AED.	43	16.3
Cardiologist direct.	93	35.2
Cardiology testing service.	14	5.3
Chest clinic.	6	2.3
Stroke/TIA clinic.	4	1.5
General surgical clinic.	4	1.5
Memory clinic.	2	0.8
Total.	264	100

Many individual examples existed about how and where in the process the GP role became active. Two examples are presented here, the first is Patient #149 (Figure 10). In this example, a GP detects an irregular pulse, organizes an ECG and then discusses the findings over the telephone with an on-call cardiologist. It is only after the specialist's advice that the GP then agrees to refer onward for warfarin initiation.

Figure 10. Patient #149. GP case-finding.

Day 1: Late 2011 sees GP#2 with cough pulse irregular. ECG requested.
Day 29: ECG done in-house.
Day 37: GP#2 reviews case in collaboration with cardiologist on the phone agree to commence Bisoprolol, (HR 130), Aspirin and refer for warfarin as CHA_2DS_2-vasc =4 (incorrect score). Awaits an echocardiogram.
Day 41: GP#2 makes OAC referral.
Day 55: Warfarin starts.

The second example, Patient #132 (Figure 11), involved an outside agency who then requested that the GP initiate a referral for OAC. Both cases show GP reliance upon advice of secondary care providers about OAC directions and latterly, how secondary care, use GPs for the initiation of OAC.

Figure 11. Patient #132. Secondary-care referral to GP for OAC.

Day 1:	Early 2004 Attends heart failure nurse clinic mentions flutter in chest and has an irregular pulse. Referral by letter to secondary-care cardiologist team.
Day 10:	ECG done atrial flutter diagnosed. To commence warfarin. GP to arrange, letter sent.
Day 34:	GP refers to anticoagulation intent to initiate warfarin, date commenced unknown.
Day 51:	Enrolled onto near patient testing system.

In total, there were only 26 referrals made by the GPs to the OAC clinics for the initiation of warfarin, and as had been shown above, some of these were on the advice of other clinicians. However, there were also cases were the GP acted independently in the decision to start warfarin. The case of Patient #131 (Figure 12) showed how the general-practice staff managed a case of a patient with an irregular pulse suspected of having a new AF diagnosis.

In this example, three practice referrals were made, involving 6 patient appointments, and taking nearly three months before a treatment decision was made. The length of time taken to detect, and initiate warfarin, highlights the difficulties that patients have, which may further contribute to negative experiences about warfarin.

4.5.5 AF diagnosis.

Figure 12. Patient #131. The GP decided to start warfarin.

Day 1:	Late 2012 Attends for a routine diabetic check at surgery sees PN#5 “feeling unwell” pulse irregular thinks it may be adverse drug reaction to meds refers to GP for review.
Day 2:	GP#3 reviews pulse still irregular. ECG requested.
Day 2:	ECG at outpatients = AF.
Day 17:	AF coded $CHADS_2$ score = 2. Warfarin declined.
Day 34:	GP#3 reviewed refers to haematology for warfarin initiation (no echocardiogram).
Day 75:	Warfarin starts.

On average, men were found to be diagnosed five years younger than women, with the mean age for diagnosis being significantly lower in men (67.23 years, SD 12.63) than for women (72.18 years, SD 10.77) (t = -3.50, df = 279, p = 0.001, 95%CI: -7.73 to -2.17). The diagnosis of AF was made in different settings (Table 26), and confirmatory data was available for 89.6% (266/297) on the AF register. Overall, excluding patients with missing data (n=31), AED diagnosed AF in 97/266 cases (36.5%).

Table 29. Who makes the diagnosis?

AF diagnosed by:	The frequency (%) of AF diagnosis made. (All AF patients 2013).
AED.	97 (36.5)
GP.	74 (27.8)
Cardiac clinics.	47 (17.7)
Wards.	34 (12.8)
Outpatients (mixed).	14 (5.3)
Total.	266 (100)
Missing data 31/297(10.4%).	

Overall, the GP initially Read-coded a diagnosis of 74/266 (27.8%) of all AF cases (Table 30). However, the GPs referred a total of 94 cases (35.2%) for ECGs, the remainder of whom had their AF diagnosis initially recorded elsewhere. In those for whom there was data about an ECG (n =267) the GP-requested ECGs, took an average of 10.20 days (mean, SD 38.98) which include both in-house and external sources. Many examples of lengthy delays in initiating OAC were found, corresponding to multiple reasons, which included complex investigations and patient choice. One example of this shows the GP referring for cardiac investigations via an ambulatory cardiology assessment clinic, and the potential for patients to get lost in systems (Figure 13).

Figure 13. Patient #261. Patient lost to follow up.

Day 1: Mid 2010, GP#4 ankle swelling symptoms – for bloods and review pulse not recorded.
Day 11: GP#4 refers for echo no ECG.
Day 36: Cardiology clinic AF detected. "you may wish to assess his $CHADS_2$ score with reference to his AF and consider formal anticoagulation with warfarin" - no $CHADS_2$ score given.
Day 74: GP#4 Warfarin declined no $CHADS_2$ score CHA_2DS_2-VASC =4.

Day 1: Early 2012 Cardiology clinic – request GP to commence Warfarin no $CHADS_2$ score.
Day 8: Seen in anticoagulation clinic.
Day 14: Warfarin starts.

It is quite possible that this delay in follow up could have affected the patient's choice to commence warfarin, as the patient's second experience shows a more effective timeline and OAC outcome. In this example, it took two months for a diagnosis and to arrange a patient consultation to discuss OAC, which may also be complicated by the non-direct advice from the cardiology report of the investigation. The patient in this example initially declined warfarin, and there is missing data showing how they remained under the care of the specialist. An analysis was undertaken between the two most common groups (GP versus AED) where patients either initially present or where diagnosed with AF and treated with OAC. However, comparing the mean number of days between clinician groups and AF

diagnosis using a *t*-test was deemed not statistically accurate due to the skewed distribution of results that included one or two outlying cases which extended the range of time until diagnosis, as described above. Therefore, conversely, when comparing patients who initially presented to the GP and AED (136 versus 60 cases) a Mann-Whitney *U*-test showed that there was no statistically significant difference in the time taken to diagnose AF with a median of days of 115.5 versus 59.89 (U= 1763.5, *p* (2-tailed)= 1.80). A further analysis was also undertaken to compare GP versus AED diagnosed AF from these initial presentations. Of the patients where this could be specifically identified (n=170), there was also no statistically significant difference between the median number of days between the GP (112.2 days) versus AED (65.4 days) diagnosing AF from first presentation (*U* test = 1590.0, *p* (2-tailed) =1.20). However, a final analysis was also conducted to compare patient first presentation between the GP versus AED median number of days and starting any OAC. Of the patients where complete data was available (n =119), there was a statistically significant time difference between GP (67.0 median days) versus AED (40.2 median days) until commencing OAC (*U* test = 751.0, *p* (2-tailed) =0.0001). Therefore, in non-urgent situations involving the GP, it appeared that, although patients may choose to decline starting warfarin, patients may also experience lengthy delays in OAC management due to the nature of the symptomology, investigations and communications between managing clinicians. Furthermore, lengthy delays may also increase the risk of patients being lost to follow-up and being left at-risk of stroke. In a late addendum to this study, the practice also experienced a significant event, in the form of a complaint regarding the communication of an AF diagnosis from an ECG performed external to the practice. In the time between the referral and the GP being informed of the new AF finding, the patient suffered a stroke. The delay in communication and action of this finding became the focus for a critical incident and formal complaint. This further highlights the importance of a timely diagnosis and early action promoting the use of OAC in general practice.

4.5.6 AF Type.

AF typing was poorly applied, with only 32.0% (95/297) having a descriptive type label (Table 30). Over 57.2% (170/297) had no documented classification of their AF. A further 10.8% (32/297) had missing data on where the criteria were applied. Of those patients

where it was possible to identify where and if an AF type was used, only 35.8% were described as paroxysmal AF or permanent AF (95/265). The GPs classified AF type in 21/74 (28.4%) of the patients that they diagnosed AF which related to 22.1% of all the coded AF patients (Table 30). However, the GPs also failed to apply an AF classification in a further 31.2% (53/170) of all those cases, with no AF type. Similarly, the cardiology clinics also only managed to classify 21/47 (44.7%) of their diagnosed patients.

There was a significant association between whether the diagnosis of AF was made by a GP or non-GP, with the category of AF stated (χ^2 = 16.1, *df* = 2, *p* = 0.003). Furthermore, there was a significant association between whether GPs or Non-GPs diagnosed the AF as paroxysmal or not, with 36.0% of non-GPs and 17.6% of GPs diagnosing PAF (χ^2 = 8.58, *df* = 1, *p* = 0.003, OR: 0.38, 95%CI: 0.19 to 0.74).

Table 30. Who made the diagnosis of AF and type?

AF diagnosis made by:	AF type coded.			Not stated number (%). 170 (64.2)	Total number (%) of AF typed by clinician.	Total number (%) of all patients with data where AF typing was possible
	Paroxysmal. 83 (31.3%)	Permanent. 12 (4.5)	Total number (%) of AF typed comparing clinicians.			
	Number (%) of AF Read-coded by type.					
GP.	13 (15.6)	8 (66.7)	21 (22.1)	53 (31.2)	21/74 (28.4)	74 (27.9)
Com Clinic.	0	0	0	5 (2.9)	0	5 (1.9)
AED.	33 (39.7)	1 (8.3)	34 (35.8)	63 (37.1)	34/97 (35.1)	97 (36.6)
Cardiac OPD.	20 (20.1)	1 (8.3)	21 (22.1)	26 (15.3)	21/47 (44.7)	47 (17.7)
WARD.	15 (18.1)	1 (8.3)	16 (16.8)	17 (10.0)	16/33 (48.5)	33 (12.5)
Outpatients other.	2 (2.4)	1 (8.3)	3 (3.2)	6 (3.5)	3/9 (33.3)	9 (3.4)
Total of AF type.	83 (100.0)	12 (100.0)	95 (100)	170 (100.0)	-	265 (100)

Table 31. AF-type coded and OAC use.

	The type of AF coded.			
Patients taking OAC.	Paroxysmal.	Not stated.	Permanent.	Total.
N (%).	33 (23.7)	97 (69.8)	9 (6.5)	139 (100.0)
	χ^2 8.75	*df* 2	*p* 0.01	

However, there was a statistically significant association found, between current OAC use and Read-coded AF type, with most patients (97/139, 69.8%) having no AF classification (Table 31). This supports the notion that AF classification may not be an important factor in OAC uptake in general practice.

4.5.7 Stroke-risk profiling.

Stroke-risk was not always documented explicitly. Table 32 shows the distribution of AF cases within the caseload against the key dates for the publication of the $CHADS_2$ risk-score (Gage *et al* 2004) and the CHA_2DS_2VASC risk-score (Lip *et al* 2010). Of those patients with data available, only 18.2% (48/264) of cases were diagnosed prior to the publication of $CHADS_2$ risk-scoring.

Table 32. Frequency of diagnosis against key dates for risk scoring.

Year of key changes.	Number (%) of AF diagnoses recorded in patients' electronic record.
< 2004.	48 (18.2)
2004-2010.	115 (43.6)
>2010.	101 (38.3)
Total.*	264 (100)
*Missing data = 33.	

Subsequent guidelines may have also influenced GP-documentation of AF and then stroke-risk. Table 33 shows the dates of the first documented stroke-risk scores in the clinical record. In the years 2008-2011, all Read-codes were entered via secondary care documents. However, there is an increase in the documented $CHADS_2$ risk-score in 2012, which most likely corresponds to practice efforts to assess stroke-risk burden ahead of the changes that were expected to come in the following QOF-year, when practices would be paid for assessments of $CHADS_2$ risk-scoring, and the percentage of treatment decisions on which they were based (British Medical Association & NHS Employers 2013).

Table 33. Year actual stroke-risk documented.

Year risk-scored.	First $CHADS_2$ frequency documented.	First CHA_2DS_2VASC frequency documented.
2008.	2	-
2009.	5	-
2010.	10	3
2011.	44	31
2012.	192	64
2013.	25	6
	Yes =278/297 (93.6%).	Yes = 104/297 (35.0%).

Stroke-risk factors were also retrospectively applied to the time of diagnosis and not the time when the $CHADS_2$ and CHA_2DS_2VASC risk-scores were commonly used. Missing data 9.1 % (27/297) of the AF caseload from which to undertake retrospective risk-scoring. Therefore, of those patients with available data, it was found that 69.6% (188/270) of all patients had a $CHADS_2$ risk-score of ≥1, with hypertension being the most common stroke-risk factor (185/270, 68.5%), followed by Age>75 (152/270, 56.3%); Diabetes (75/270, 27.8%); heart failure (73/270, 27.0%) and previous stroke/transient Ischaemic attack (51/270, 18.9%). Similarly, when applying the updated CHA_2DS_2VASC risk-score retrospectively to those with data (90.9%, 270/297) the number of higher-risk patients (CHA_2DS_2VASC risk-score > 1) rose to 76.7% (207/270). This indicated that most patients

were eligible for OAC based upon stroke-risk. The use of HASBLED scoring was limited to 105/297 (35.4%) of all patients, and these were limited to those managed by the GP in-house OAC clinic only.

4.5.8 Managing stroke-risk with OAC.

At some time, 66.7% (198/297) of patients within this cohort had been treated with warfarin. At the point of accessing this database, only 47.8% (142/297) were currently taking warfarin, with a further eight people (2.6%) taking a NOAC drug. A total of 50.4% of this AF caseload was therefore, currently receiving OAC. There was no difference in mean age between those currently using and not currently using OAC (95%CI: -3.25 to 2.42 years, $p = 0.78$), or age at mapping assessment (95%CI: -2.94 to 2.22 years, $p = 0.78$) using a *t*-test (Appendix 16, P.375).

Over thirty percent (38.4% 114/297) were taking aspirin for stroke-prevention, of these, 16/114 patients (14.0%) were taking both aspirin and warfarin. However, there was some evidence that GPs were using aspirin as an interim measure to manage stroke-risk whilst seeking further expert opinion an example of this was found in Patient #61 (Figure 14).

Figure 14. Patient #61. GP use of interim Aspirin.

Day 1:	Early 2011 Attends to see NP with chesty cough Pulse recorded as irreg-irreg. ECG requested.
Day 7:	Attends outpatients for ECG recorded as AF.
Day 20:	Attends GP review AF coded. Aspirin commenced cardiology referral made for assessment for cardioversion/warfarinization/confirmation of AF type. ***"…Grateful for the assessment of…X appears to have AF; we are unsure as to how long…I have commenced X on aspirin today but would value an assessment for cardioversion and warfarin"***
Day 60:	Seen in clinic. AF typed; warfarin refused.

Overall, the GP decided to use APL at least 59 times, as part of a referral process, many of which (38/56, 67.9%) included referral for ECG. However, the odds of the GP not using APL in these referral (no vs yes), was only statistically significant when referring patients to cardiology ($\chi^2 = 4.94$, $df = 1$, $p = 0.03$, OR: 2.48, 95%CI: 1.11 to 5.55) and for an ECG ($\chi^2 = 6.12$, $df = 1$, $p = 0.01$, OR: 2.7, 95%CI: 1.23 to 6.30) (Appendix 16, P.375). Finally, another 13.8% (41/297) of all patients had no treatment, whilst a further 33% (98/297) of patients on this caseload were also being inappropriately treated with aspirin alone. The use of monotherapy with aspirin was against current advice (NICE 2014). These results reflected the lack of active roles of GPs in routinely organized, systematic AF/OAC reviews.

However, at some point, 70.2% of all males and 62.5% of all females had taken warfarin, although there was no significant association found between the proportions of males versus females, or patients aged under 75 years versus patients aged over 75 years to have ever taken OAC (Appendix 16, P.375).

The treatment of both OAC and aspirin, varied between stroke-risk categories that were mapped during this study, after applying the CHA_2DS_2VASC criteria (Tables 34 and 35). Only 50.4% of patients in total were taking current OAC, of whom 89.1% were deemed high-risk by CHA_2DS_2VASC score (Table 34). However, a further 38% of patients were instead taking aspirin, of which a worrying 92.3% were also deemed high-risk by CHA_2DS_2VASC score (Table 35).

Table 34. Calculated CHA_2DS_2VASC & OAC use.

	Overall OAC use total (%). Of those with data (n=274)	**CHA_2DS_2VASC risk-score.**	**0**	**1**	**≥2**
Current OAC used.	Yes = 138 (50.4)	Number (%) at-risk & OAC used.	3 (2.2)	12 (8.7)	123 (89.1)
	No = 136 (49.6)	Number (%) at-risk & OAC not used.	2 (1.5)	9 (6.6)	125 (91.9)

Table 35. Calculated CHA_2DS_2VASC & APL use.

	Overall OAC use total (%). Of those with data (n=274)	**CHA_2DS_2VASC risk-score.**	**0**	**1**	**≥2**
Current APL used.	Yes = 104 (38.0)	Number (%) at-risk & APL used.	2 (1.9)	6 (5.8)	96 (92.3)
	No = 170 (62.0)	Number (%) at-risk & APL not used.	3 (1.8)	15 (8.8)	152 (89.4)

However, using a χ^2-test, the odds of OAC use, was not found to be statistically significantly different in high-risk AF patients than in low-risk AF patients when using $CHADS_2$ risk-score (OR: 0.88, 95%CI: 0.53 to 1.47, p = 0.63), or APL (OR: 1.57, 95%CI: 0.92 to 2.69, p = 0.10) (Appendix 16, P.332). However, when applying the CHA_2DS_2VASC risk-score, high-risk AF patients were statistically associated with three times greater odds of being treated with

OAC than those with a lower risk score (χ^2 = 4.51, *df*=1, OR: 3.78, 95%CI: 1.02 to 14.04. *p* = 0.03), but there was no statistically significant association with APL use (Appendix 16, P.375). The results suggest that these patients were not being treated because of their stroke-risk at that time, but that the CHA_2DS_2VASC risk-score better represented those at higher risk who should be treated with OAC, which reflects much of the literature found in the previous review. One possible reason for this is that most of the $CHADS_2$ risk-scores and the CHA_2DS_2VASC risk-scores used in this study were done subsequent to diagnosis in 2012. The former, being representative of the QOF changes, and thus practice requirements. However, acting upon the stroke scoring, would require another process and take significant time to enact, which was not reflected in this data. Therefore, it is more likely, that only newly diagnosis patients were accurately treated as per their stroke-risk.

4.5.9 Decisions made by GPs.

An analysis of GP-stroke prevention medication decisions revealed that a total of 424 decisions were identifiable within the patients' journeys. However, the GPs were only involved in 85/424 (20.1%) occasions of "*any decisions*" about stroke prevention medications. Of these, 20 (23.5%) of GP decisions affected the same patient more than once. Of the GP decisions, 68.2% (58/85) were to commence aspirin, mostly concerning "*non-urgent*" clinical pathways. Only 47.1% (40/85) of any decisions by the GP were to commence OAC, and of these, only 37.5% (15/40) started treatment. Of the 85 occasions where a prescribing decision was made by a GP, only 35 (41.2%) resulted in OAC use. A χ^2 test showed a significant association between GP decisions and current OAC use, with an approximately 44% reduced odds, that GP decisions would lead to current OAC use relative to decisions made by others (χ^2 = 4.71, *df* = 1, OR: 0.56, 95%CI: 0.34 to 0.95, *p* = 0.03).

Two possible reasons for this were that GPs didn't routinely measure, and thus interpret, an individual's stroke-risk, and it was also evident that many patients were resistant to the suggestion for warfarinization. For example, for Patient #261 (Figure 15), who was an 86-year-old, with a retrospectively estimated CHA_2DS_2VASC risk-score of 4, the patient record lacked any evidence of how stroke-risk may have been discussed as part of the decision to not use OAC, either by the GP or the cardiologist.

Figure 15. Patient #261. GPs using stroke-risk scores.

Day 1: Early 2010, GP#4 ankle swelling symptom. Refers for bloods and review pulse not recorded.
Day 11: GP#4 refers for echo no ECG.
Day 35: Cardiology clinic AF detected. "you may wish to assess his $CHADS_2$ score with reference to his AF and consider formal OAC with warfarin." - no $CHADS_2$ score given.
Day 71: GP#4 Warfarin declined no $CHADS_2$ score CHA_2DS_2VASC.

A further example of this was Patient #255 (Figure 16), whereby, the GP incorporated cardiology "*rapid access systems*", with the cardiology recommendation to use the $CHADS_2$ risk-score, and for the GP to then decide on the need for warfarinization. Both access to diagnostic testing and stroke-risk discussions with the patient appear to be not rapid or concise, according to the patient records.

Figure 16. Patient #255. Cardiology suggests GP scores stroke-risk.

Day 1: Early 2010, GP#5 palpitations/dizzy pulse regular. ECG requested.
Day 1: ECG done at outpatients = sinus rhythm.
Day 31: GP#5 review still with palpitations pulse regular. Refers to direct access cardiology for 24-hour ECG.
Day 57: Cardiology review. AF on tape. GP "*to decide on need for warfarin*" - suggest he uses $CHADS_2$ score but doesn't score it himself!
Day 97: GP#5 reviews. warfarin declined no $CHADS_2$ risk-score!

Figure 17. Patient #118. GP hesitancy starting OAC.

Day 1: Late 2004, Sees GP# 5 with palpitations at rest, referred on direct access cardiology tests pathway for 24-hour ECG.
Day 22: AF seen in cardiology outpatient's clinic suggests increase Atenolol dose and "*if his $CHADS_2$ score > 2 you may wish to consider formal OAC with warfarin.*"
Day 55: GP#5 refers to cardiology for OAC opinion.
Day 85: Cardiologist agrees should be on warfarin.
Day 99: OAC assessment for warfarin in OAC.
Day 106: Warfarin starts.

The second evident reason seemed to be an over reliance on aspirin as first-line choice antithrombotic for the GPs. This was demonstrated repeatedly and may have been underpinned by an uncertainty about the need for, or confidence in, deciding on OAC in Patient #118 (Figure 17), and/or the need for cardioversion as shown in the example of Patient #259 (Figure 18). However, as the GP had no services or direct role in initiating warfarin at that time, they therefore had to rely upon specialist opinion and instruction, to enter patients into OAC initiation services which were secondary care based.

Figure 18. Patient #259. Cardioversion, a reason for GP referral for OAC.

Day 1: Late 2006, GP#3 empty consultation.
Day 11: ECG done at outpatients faxed shows AF.
Day 12: GP#4 "*awaiting bloods so see with results – AF so will need warfarin*. "
Day 20: GP#3 "*chat re ECG "query for warfarin/cardioversion*" referral to cardiology. Starts aspirin.
Day 75: Cardiology clinic referral for 24-hour tape, stay on aspirin for now? Warfarin later no $CHADS_2$ score.
Day 75 Cardiology review adds Digoxin.
Day 168: Cardiology review for warfarin "*in view of age*" no $CHADS_2$ score.
Day 193: GP refers to OAC clinic.
Day 201: Warfarin starts.

The GPs did make decisions to start warfarin, and there were 23 examples whereby the GPs suggested the need for warfarin and patients declined, and these happened in different ways. Patient #210, for example (Figure 19), had historically declined warfarin by previous clinicians, and more recently, by both the cardiologist and the GP, using aspirin instead.

Figure 19. Patient #210. Patients decline warfarin offered by GPs.

First entry: Early 2001, Coded diagnosis only AF and flutter. No action.
Day 1: 10/11/10 GP#5 refers cardiology about a new murmur. "*known AF*" taking aspirin.
Day 66: Cardiology clinic $CHADS_2$ risk-score = 2, warfarin declined.
Day 93: Cardiology clinic warfarin declined.
Day 133: GP#5 warfarin declined stroke-risk discussed.

Whereas some patients, like Patient #32 (Figure 20), had historically, and before the advent of $CHADS_2$ risk-scoring, been using aspirin and preferred not to change. This also highlighted the difficulties of managing historical AF patients not taking OAC.

Figure 20. Patient #32. Patient's historical aspirin preference.

Day 1: Early 2009, Attends the GP with swollen ankles and raised BP. ECG requested.
Day 5: ECG shows AF, "*pulse Irregular*" already on aspirin……
Day 1: Mid 2011, First documented $CHADS_2$ risk-score.
Day 271: Documented stroke-risk discussed "*Warfarin declined*." Attends to the GP with palpitations. Stroke-risk discussed/warfarin declined.

Further patients held strong beliefs about warfarin that the GP was unable to affect, such as the example of Patient #132 (Figure 21). However, many other patient reasons for declining warfarin were not documented within the records.

Figure 21. Patient #132. Patient negative warfarin beliefs affecting uptake.

First entry:	Late 2006, First AF code no explanatory data. Digoxin on list (now stopped) since 07/09/07.
Second entry:	Mid 2008, Sees GP#4, ECG done at request of optician. Warfarin declined (believes sister died because of taking warfarin). Already on aspirin.
Day 1:	Mid 2011, Sees GP#2 after recent stroke at hospital away from home. Referred stroke clinic.
Day 3:	Warfarin recommended. Long chat agrees to start.

GPs were also often asked to act upon advice or enact decisions by other clinicians. There were also 22 other case-examples, such as, Patient #147 (Figure 22), where the cardiologist recommended that the GP either should commence warfarin or instruct them to organize initiation, on their behalf.

Figure 22. Patient #147. GPs instructed to commence OAC.

Day 1:	Late 2009, Sees GP#7 suspects heart failure from symptoms of breathlessness and ankle swelling no pulse recorded. Refers In-house for ECG.
Day 1:	Undergoes ECG in house. Clearly, AF nothing documented.
Day 7:	GP#7 reviews still no mention of ECG or pulse in notes. Refers open access cardiology assessment. *"? heart failure*."
Day 48:	Seen in cardiology clinic $CHADS_2$ = 2 scored, AF diagnosed. Warfarin recommended.
Day 74:	GP#7 refers to OAC clinic.
Day 84:	Warfarin starts.

However, other clinicians also invited the GP to process decisions or referrals. These requests often involved lengthy delays in initiating warfarin, as seen in Patient # 185 (Figure 23). Of all the treatment decisions made by GPs, the GPs commenced a novel anticoagulant 4 times and stopped warfarin 12/118 times for aspirin (10.2%). The GPs did intentionally decide warfarin in 17 patients of whom, 15/17 (88.2%) did start OAC. Although the frequency of warfarin decisions differed between GPs and cardiologists, the GPs were as successful at implementing decisions about warfarinization as the cardiologist.

Figure 23. Patient #185. GPs are invited to consider referral for OAC.

Day 1:	Early 2009, GP#2 Sees with chest infection. Pulse irregular *"? AF"* for ECG and bloods.
Day 3:	ECG = AF.
Day 4:	GP# 2 reviews cardiology referral made starts Aspirin "*query for warfarin"* no $CHADS_2$ score.
Day 66:	Seen in medical clinic by consultant (stroke) *"low-risk in my opinion but would accept warfarin if needs*." Refer for 24-hour tape.
Day 131:	Stroke consultant reviews. Not for warfarin in her opinion but writes to cardiology for advice.
Day 159:	Cardiology $CHADS_2$ risk-scores 2 and recommends warfarin.
Day 201:	GP#3 refers to OAC clinic.
Day 213:	Warfarin starts.

The cardiologists made 72% (306/424) of all antithrombotic decisions, and 60.8% (186/306) of these decisions, were to commence OAC, of whom, 87.6% (163/186) of patients started treatment. However, the mean age of people for whom cardiologists made decisions was lower than the age of those for whom decisions were made by their GP counterparts (mean (SD) age 68.5 (10.94) vs 71.2 (10.05) years; t =0.77, df =220, p=0.03, 95%CI 0.49 to 7.33 years younger).

4.5.10 Patient pathways: first symptoms to OAC decision.

Altogether, all pathways led to an uptake of OAC in around 65% (calculated from patients with data, n = 176/272). It was previously shown that the GP-initiated pathways accounted for over 57.7% (157/272) of all presentations (Table 26, p. 144). However, of these, only 65.6% (103/157) resulted in OAC, which represents 58.5% (103/176) of all patients' pathways which resulted in OAC (Table 36).

However, this also means that 34.4% (54/157) of all patients whose pathways were initiated by GPs resulted in no OAC. This contrasts with the Accident & Emergency (AED) pathway, which accounted for 37.8% (65/172, Table 26, p. 144) of all first presentations. Of these, 65 presentations, 69.2% (45/65) resulted in favorable OAC outcomes.

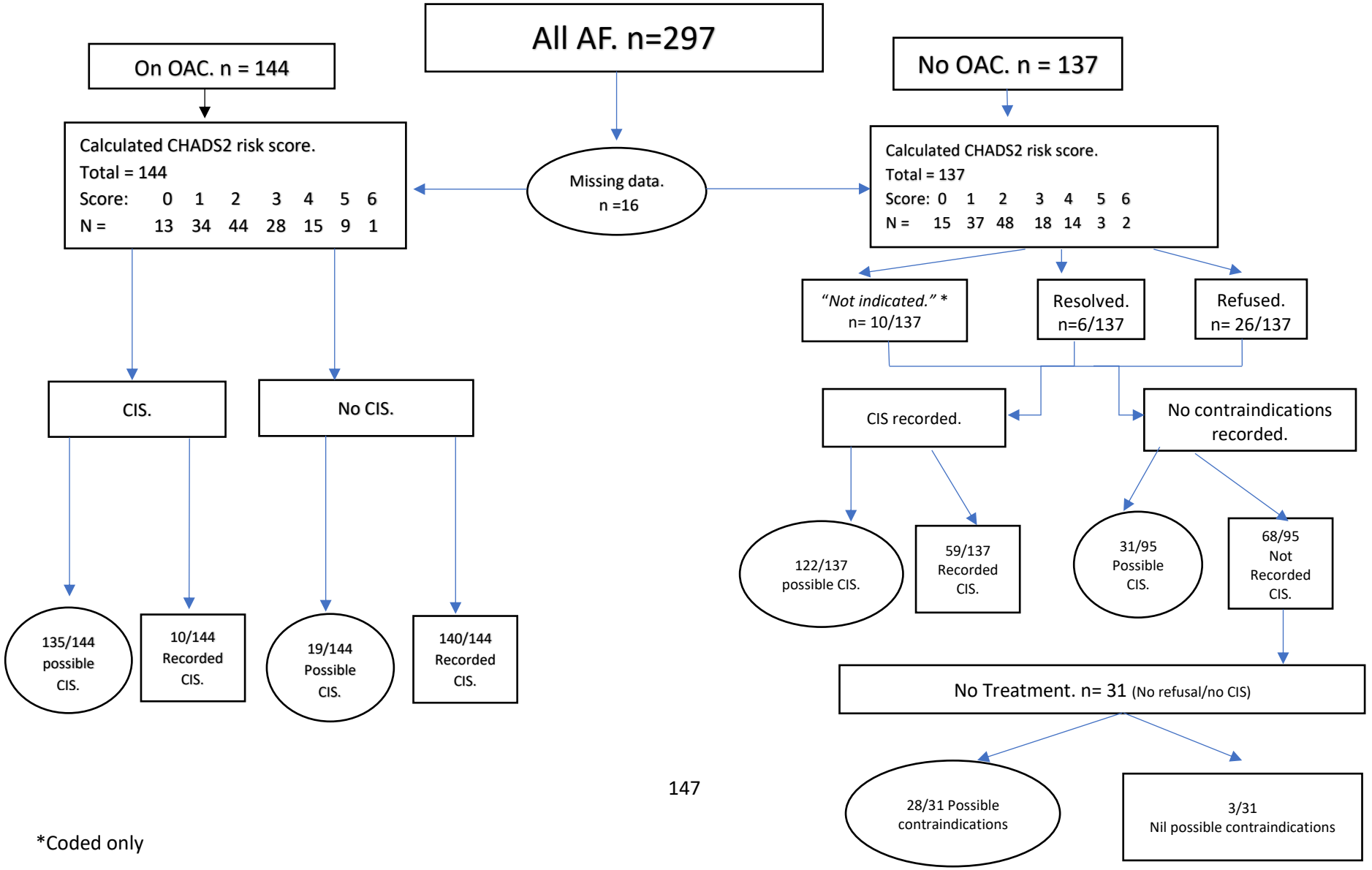
Table 36. Patient pathway: first symptoms to OAC decision.

Patient pathway.	Frequency (%) of patients that resulted with OAC.
GP-urgent.	32 (18.2)
GP non-urgent.	62 (35.2)
GP non-urgent becomes urgent.	9 (5.1)
Total GP.	**103 (58.5)**
AED.	45 (25.7)
Ward.	5 (2.8)
OPD.	21 (11.9)
Walk-in centre.	2 (1.1)
Total non-GP.	**73 (41.5)**
Total.	176 (100)
Missing data = 25.	

4.6 Non-use of Warfarin.

Figure 24 maps out the available data of those treated and not treated with OAC, including those patients with actual documented contraindications for OAC and those with conditions/factors that were conceivably reasons to withhold OAC according to the findings in the literature review. These might include patients with uncontrolled hypertension, recent malignancy, and recurrent falls. There was missing data for 5.4% (16/297) of patients. Of the remaining 137 untreated patients with data, there were 54.7% (75/137) of patients whose records indicated either a Read-code of contraindication or free-text indicating contraindication. Figure 23 also shows, that a further 19% (26/137) of patients had, at some time, declined to have warfarin. However, 22.6% (31/137) of all those not receiving OAC had no documented reason for non-treatment.

Figure 24. GAPS-2: Who gets stroke prevention?
Stroke prevention in atrial fibrillation patients in a general-practice setting.



*Coded only

Figure 24 highlights the incongruous nature of OAC in this setting when trying to interpret actual OAC use with the potential reasons based on known CIS within the patients' mapped records. There was of course a total of 75 documented reasons for OAC non-use within the patients' mapped records (Table 3.7), with the most common reason for non-use of OAC relating to overt bleeding-risk (20/75, 26.7%). Patients were classified as transient AF on 6 occasions (6/75, 8.0%), and therefore, not indicated for OAC. A Read-code of "*not indicated*" was entered for 10/137 (7.3%) patient records amongst those not treated, with no other explanation as to the reason for non-indication. It was explicit in 12% (9/75) of patients that non-indication, was due to the patients being at low-risk, validated by a risk-score (Table 37).

Table 37. Reasons cited for non-use of OAC.

Documented reasons for no OAC.	**Frequency (%) of total documented reasons for no OAC.**
Bleeding, ^ bleeding-risk, Barrett's.	20 (26.4)
Anaemia.	6 (8.0)
Risk-scores low.	9 (12.0)
Read-code only documented.	10 (13.3)
Alcohol.	4 (5.3)
Falls.	8 (10.7)
AF resolved, hyperthyroid induced AF, Post DCCV.	6 (8.0)
Pre- procedure, surgery, chemotherapy.	2 (2.7)
Adverse drug reaction.	5 (6.7)
Mental capacity concerns.	4 (5.3)
Social reasons.	1 (1.3)
Total.	**75 (100)**
*No recorded reasons.	62

However, not all contraindications could be interpreted as absolute, and the GPs could take other measures before deciding on starting OAC. For example, on occasions, patients may be identified as anaemic or require further treatments during the AF assessment which might delay decisions about starting antithrombotic therapy. Furthermore, these potential contraindications may also supersede stroke prevention in importance, as exemplified by Patient #93 (Figure 25) who was found to have anaemia.

Figure 25. Patient #93. Bleeding-risk outweighs stroke-risk.

Day 1: Mid 2011, Attends GP feeling breathless, ankle swelling, cough. Refers for ECG/bloods *"pulse regular"* ECG = AF but is anaemic.
Day 16: GP#2 reviews, referral for anaemia screen, no mention of AF in referral.
Day 28: Meningioma reviewed no AF documented.
Day 44: Seen in surgery clinic AF not documented.
Day 155: Discharged after stroke. Not for warfarin due to anaemia concerns, to stay on aspirin, refer cardiology.
Day 231: Elderly cardiology review, for warfarin patient agrees. GP letter queries contraindications previous (meningioma).
Day 259: Consultant's responds good explanation with $CHADS_2$ score 4.
Day 351: Warfarin starts.

However, as temporary contraindications do change over time, it was also noted that the process of reviewing potentially high-stroke-risk was a concern. This was shown in Patient #153 (Figure 26), who was found to be in AF. However, pending chemotherapy treatment seemed to take precedence over stroke prevention and a failure to conduct an AF review may have resulted in serious consequences later.

Figure 26. Patient #153. Chemotherapy delays stroke prevention therapy.

Day 1: Early 2006, Digoxin appears on a discharge letter with no reference to AF.
Day 32: Attends the practice for an ECG = AF, verbal advice in notes "*to continue with aspirin and Digoxin"* for review.
Day 42: Sees GP#5 "*not for warfarin at present reconsider in 6/12 post pending chemotherapy*". No $CHADS_2$ risk-score. Never mentioned in notes again.

Early 2011: Admitted with dense stroke.
Day 34: Established on warfarin in hospital and ever since no $CHADS_2$ risk-score documented.

Overall, across the entire AF cohort, only three potential contraindications were found to be statistically associated with a reduction in odds for OAC use, namely, lacks capacity, falls and the use of pro-bleeding drugs. Firstly, patients with AF who lacked capacity were found to be significantly associated with less warfarin use (OR: 0.18, 95%CI: 0.04 to 0.81, χ^2 = 6.21, *df* = 1, *p* = 0.01), and with greater APL use (OR: 5.77, 95%CI: 1.55 to 21.44, χ^2 = 8.57, *df* = 1, *p* = 0.003). Similarly, AF patients with a history of falling also had a significantly associated reduction in the odds for current warfarin use (OR: 0.38, 95%CI: 0.20 to 0.73, χ^2 = 8.83, *df* = 1, p = 0.003). However, there were no associated increased odds in the use of APL in patients with a history of falling. Lastly, of the 74 patients who took pro-bleeding drugs, only 18.9% were also taking warfarin. Again, there was a significant reduction in odds for using warfarin (OR: 0.16, 95%CI: 0.85 to 0.31, χ^2 = 36.06, *df* = 1, *p* = 0.0001) for those taking rather than not taking pro-bleeding drugs and an associated increased odds for using APL (OR: 6.70, 95%C%: 3.73 to 12.03, χ^2 = 46.04, *df* = 1, *p* = 0.001)

4.7 OAC management.

Data about location of testing and therapeutic time in range (TTIR) was not available for patients who were managed outside of the practice, as this information was held externally to the general-practice systems[12]. However, by the end of this mapping study, approximately 100 patients had become enrolled onto the general-practice LES-systems, meaning that INR-testing, warfarin dosing and ongoing management were now under the direct responsibility of the general-practice. Furthermore, there was evidence that the systems underpinning the LES were also altering the way that some GPs were managing AF patients. For example, Patient #207 (Figure 27) showed how the GP preferred to retain part of the OAC management processes locally. Whereas, a further example in Patient #142 (Figure 28), showed how ongoing risk-assessment of patients taking OAC could be better controlled by enacting OAC decisions in-house.

Figure 27. Patient #207. GP uses in-house systems for warfarin initiation.

Day 1:	Late 2002, admitted unwell blackouts and palpitations found to be in AF.
Day 2:	PAF diagnosed on Amiodarone and Atenolol no further entries.
Day 36:	GP#3 see with dizziness. Possibly relating to PAF refers cardiology no $CHADS_2$ risk-score.
Day 51:	Cardiology clinic recommends warfarin due to his $CHADS_2$ risk-score – which is not stated.
Day 63:	GP#4 reviews and discusses warfarin, calculates $CHADS_2$ risk-score, refers to nurse for counselling.
Day 139:	N#1 counsels re stroke-risk and warfarin, initiates warfarin in-house.

Figure 28. Patient #142 GP uses in-house systems for warfarin switch to DOAC.

Mid 2004:	Admitted as emergency with dehydration found to be in AF commenced on warfarin Bisoprolol.
Mid 2005:	Declines to take any more warfarin due to side effects. GP discussed risks starts on aspirin no $CHADS_2$ risk-score.
Early 2011:	Suffers stroke. Re-starts warfarin no $CHADS_2$score.
Early 2013:	Review of AF with nurse#1 = poor TTIR, continued side effects, wants to try DOAC; $CHADS_2$ = 4, HASBLED score 4
Day 4:	Starts Rivaroxaban, DOAC monitoring implemented.

The LES therefore created a general practice-wide awareness and instigated the need to shape new systems to manage the DOAC patients, which were both new AF/OAC outcomes in this practice.

4.8 Section B: Newly diagnosed AF patients.

A total of 56 new AF patients were diagnosed (mainly by the GPs) following the initial mapping phase, from 24.9% to 78.6% (Table 38). Compared to the historic AF cohort, the 3-

[12] The computer Decision Support System (CDSS) used here (INRstar) auto-calculated the Therapeutic Time In Range (TTIR).

year following period showed a 53.7% increase in general-practice-diagnosed AF cases. This suggested that general-practice staff had an increasingly active role in AF case-finding.

Table 38. GP knowledge and action.

Descriptive factor.	GAPS-1.		Post GAPS-1 (10/2013 to 02/2017).	
	Number.	%	Number.	%
General-practice made the diagnosis of AF.	74/297*	24.9	44/56	78.6
The GP having diagnosed AF:				
Records a $CHADS_2$ risk-score.	72/74	97.3	6/56	10.7
Records a CHA_2DS_2VASC risk-score.	12/74	16.2	34/56	60.7
Records a HASBLED-score.	31/74	41.9	23/56	41.1
Discusses stroke-risk with patient (recorded).	24/74	32.4	29/56	51.8
The general-practice is involved in any stroke-risk-reduction decision.	77/297*	25.9	29/56	51.8
The GP decides nothing.	3/42*	7.1	4/56	7.1
The GP decides aspirin.	34/45*	75.5	2/56	3.6
The GP decides warfarin.	17/42*	40.5	2/56	3.6
The GP decides DOAC.	4/74	5.4	14/56	25.0
The GP refers to cardiology.	57/74	77.0	28/56	50.0
The GP refers to OAC clinic.	12/74	16.2	4/56	7.1
The GP questions the need for warfarin in the referral.	44/61*	72.1	18/56	32.1
The GP refers to the NC for OAC decision.	-	-	9/56	16.1
The GP refers to the NC for ongoing management.	-	-	10/56	17.9
Secondary care requests the GP consider or start OAC.	22/297	7.4	11/56	19.6
Warfarin use¥/starts.	146/297	49.2	7/56	12.5
DOAC use¥/starts.	8/297	2.7	44/56	78.6
APL use¥/starts.	117/297	39.4	1/56	1.8
Nothing-use¥/starts.	26/297	8.7	4/56	7.1

*missing data, ¥ overall antithrombotic use

Similarly, the rates of initiation of OAC use also increased by 39.2% in the period after the initial AF mapping study, from 51.9% to 91.1%, and appeared to be mainly attributable to the decreased use of APL. The overall OAC use rates also changed in character, with a 75.9% increase in the use of DOACs, from 2.7% in 2013, to 78.6% in 2017 and the simultaneous 36.7% decrease in the use of warfarin, from 49.2% in 2013 to 12.5% in 2017. A further finding indicated that there was an increase of 25.9%, from 25.9% to 51.8% between periods A) and B) concerning the rates of GP involvement in decisions about OAC. Furthermore, the emergence of nursing roles relating to AF/OAC management had become apparent. For example, the nurses were now all engaging in routine pulse checking, instigating ECGs on suspected AF cases independently (data not presented) and the GPs were also beginning to use in-house nursing expertise to initiate OAC (Table 39).

Table 39. The role of the nurse expert in OAC management.

NC role in OAC management.	2013.		2014-17.	
	Frequency.	%	Frequency.	%
The NC is involved in ANY OAC decision.	-	-	13/56	23.2
The NC decides warfarin.	-	-	0/56	0
The NC decides DOAC.	-	-	11/56	19.6
The NC decides APL.	-	-	1/56	1.8
The NC decides nothing.	-	-	1/56	1.8
The NC refers to cardiology.	-	-	2/56	3.6
The NC questions the need for warfarin in the referral.	-	-	1/56	1.8
The NC refers to OAC clinic.	-	-	0/56	0
The GP refers to the NC for OAC decision.	-	-	9/56	16.1
The GP refers to the NC for ongoing management.	-	-	10/56	17.9

Thus, in period B), the results also showed that the NC had now become involved in 23.2% of all new AF patients diagnosed within the general practice. In many of these new cases, the NC's role included the initiation of DOAC drugs (19.6%) (Table 44).

4.9 Discussion.

How do patients present who are diagnosed with AF? The data shows that GPs are at the forefront when it comes to how patients present with symptoms that lead onto a diagnosis of AF, with GP-initiated pathways accounting for over 57% (157/272) of all presentations. By far the biggest groups of patients are seen in a non-urgent manner.

Presenting symptoms: The majority of AF patients with data (200/272, 73.5%) had symptoms recorded in their notes, which was also true for those who initially attended the GP pathways (108/135, 80%). Furthermore, of all the patients' presenting pathways, 16.9% (46/272) attended the general-practice and required urgent same day referral. AF care, thereafter, including OAC decisions, will have been undertaken by secondary care. Therefore, the general-practice has a potentially central role in influencing patients about OAC decisions, but other clinicians are also influential in the OAC process of general-practice patients. However, the processes involving general-practice were found to be complex, including a variety of patient-pathways that included various referral options.

Referrals: The data shows that GPs made 264 referrals for the patient group up to diagnosis and first treatment decision. The diagnostic process either began with the detection of an irregular pulse or a general screening and the request for an ECG. Most GPs in this practice used an outpatient ECG-service and as such, anything up to 2 weeks of delay may ensue

before a report was received and the GP got the information needed to make a diagnosis. This happened on multiple occasions, after which a decision was required, as to treat or refer for more advice. A further 35.2% of all GP-referrals were to cardiologist outpatient-clinics, and these were all supported by ECG evidence. Most of these referrals included GPs enquiring specifically about the need for patients to be anticoagulated. Interestingly, there were also occasions whereby, the cardiologist referred to the GP, either supporting the GP view of the need to anticoagulate, and/or advising him to refer onto an OAC clinic to commence warfarin. All these referral pathways could incur long delays between decisions to refer and follow-up with a decision to treat, which may also increase the risk of being lost to follow-up. The older patients (whom are at increasing risk of AF) are perhaps most at risk of being lost to follow up and/or subject to having experienced long delays here. I hypothesized that this may largely be due to systems and controls, but also that it is complicated by the patients themselves. Older patients may be more inclined or reliant upon a paternalistic belief which the system will always work for them. For example, some patients, due to their expectations, wait to be told or reminded to attend appointments. Similarly, patients can experience multiple appointments across different locations. These factors are also potential barriers for older patients concerning OAC. This is due to the increased likelihood of both social and cognitive dysfunctions that these older patients may have to contend with when arranging and attending these appointments. Furthermore, it was also observed that there were limited precautionary systems for following up patients going through a referral process in practice, which may be an influencing factor for OAC use. Further research concerning AF patients' experiences of, and how, general-practices organize investigative and referral systems, would be useful to enable improvements within general-practice on this subject. Furthermore, streamlining services for patients and enabling the GPs' role in OAC decisions will reduce delays and increase OAC uptake in the future. However, this depends upon GPs and nurses being prepared to take responsibility for diagnosis and OAC decisions themselves. Yet, the data here suggests that there are parts of the GP role that would require change to enhance OAC uptake.

Who makes the diagnosis? GPs seem to be quite involved in diagnosing AF, with 27.8% (74/266) making this diagnosis and being ranked only second to AED, who diagnosed most cases (36.4%, 97/266). However, most cases of AF were not typed (57.2%, 170/297), which

included 71.6% (53/74) of the patients diagnosed by GPs. This lack of labelling of the type of AF may have been an important factor in deciding OAC use and the OAC rates found. For example, all patients with permanent AF Read-coding (n=12) had tried OAC (all clinical areas), compared to only 59% (49/83) of PAF cases. It was apparent that making and or typing the AF diagnosis didn't equate to the GP deciding about OAC.

Stroke-risk profiling should have theoretically guided the GPs about the need for OAC, once they were familiar with, and actively implementing, the $CHADS_2$ risk-scoring. Indeed, a high compliance with the QOF requirement was demonstrated, with 93.6% (278/297) of the AF caseload, having a $CHADS_2$ risk-score completed in the record. The peak $CHADS_2$ risk-scoring incidence recorded in patient records in 2012 (n=161), corresponded to the time when the practice began to assess the AF caseload proactively; this was before the $CHADS_2$ risk-score was an expectation of the QOF. However, this wasn't reflected in the levels of expected OAC uptake in accordance with the stroke-risk measured. As the post 2014 analysis shows, it is only when the nurses become fully engaged that the utilization of OAC is reflected in those with increased stroke-risk. This indicates that the nurses here played a vital role in the stroke-risk-reduction strategy of the practice.

A further 35.0% (104/297) had a CHA_2DS_2VASC risk-score, with a similar number having a HASBLED score (105/297, 35.4%). However, the majority of these were in relation to those patients whose OAC therapy was managed within the general-practice. These findings suggest that there was a lag between guideline publication and implementation via systems to manage historic stroke-risk in practice. The $CHADS_2$ risk-scoring was introduced as a QOF requirement (NHS Commissioning Board 2013), initially to identify stroke-risk. This study found that the $CHADS_2$ risk-scores were applied retrospectively to the time of diagnosis, following the introduction of the QOF-requirement. Furthermore, at that time, there were no incentives or systems in place to manage unidentified stroke-risk in this population. Therefore, the GPs may have lacked the incentive and/or resources to act upon the stroke-risk found. Further research is required to verify this claim.

OAC use: Both, old age and gender, were not found to be statistically associated with current or previous OAC use, and only those AF patients who were retrospectively scored as high-risk using the CHA_2DS_2VASC risk-score had statistically increased odds for OAC use. Conversely, AF patients who fell, lacked capacity or used pro-bleeding drugs had

significantly lower odds for OAC use and increased odds for APL use. This suggests that the clinicians were not being guided by stroke-risk, but some patient-specific factors might have been weighing more heavily on clinicians' decisions to use OAC, with a clear preference for APL as a stroke prevention treatment. These findings are generally in keeping with those found within the literature review. Yet, further research is required to understand just how the GPs here decided between OAC and APL.

Pathways: It was also considered that the type of pathway may have influenced the outcome of OAC use in GP assessed AF cases. GP-urgent referrals sometimes, but not always, included patients whose journey took them to AED and whom had easy access to investigatory systems that could lead to early OAC decisions. However, an examination of the non-urgent GP-pathways found a total of 99 patients (36.4% of all pathways), resulting in 62/99 patients (63% of the GP-non-urgent pathway) being treated with OAC. In comparison to GP-urgent cases, 69.2% had favorable OAC outcomes which represented a non-significant 6% difference between GP-non-urgent and urgent pathways (χ^2 0.16, *df* 1, *p* 0.81).

Lastly, OAC treatment uptake, as a percentage of case pathway type between GP-non-urgent, GP-urgent and direct AED, were all similar. This suggested that the level of urgency of the presentation, and/or, the role that the practitioner, plays during these pathways did not affect OAC uptake. However, there is a need to examine the GP role further, to understand how these levels can be improved in practice.

GPs involvement in decision-making: The data here shows that although the GPs were responsible for the entire AF caseload, in the historic AF caseload to the point of this mapping study, they had previously only been involved in only 27.8% of the decisions made about stroke-prevention. GP decision rates did increase to 51% in new AF patients after 2012 up to 2017. However, in the initial mapping most of the 118 decisions that the GPs made about antithrombotics, favored antiplatelet therapies instead of OAC (58/118, 49.2%). The data also showed that the majority of all routine GP referrals to cardiology also included references to enquiries about the need to commence OAC (57/93, 61.2%). These referrals were often supported by stroke-risk-profiling information. On reflection, this suggests that the GP either lacked knowledge as to what this information meant, and/or, that they were

not comfortable about taking responsibility for the decision to anticoagulate the patients for other reasons.

Lastly, there were also 22 occasions when the cardiologists responded to GP referrals in agreement with the GPs' recommendations to use OAC and further recommending that the GP then refer to the warfarin clinic. It may be that the GPs were less aware of how to measure and discuss the individual patient's stroke-risk. Furthermore, the GPs may have also demonstrated less authority, and thus influence, on patient's decisions to start warfarin. However, the patients also experienced the systems via pathways that led to decisions about OAC very differently. These pathways may have also influenced their choices about OAC.

Nurses' roles in OAC management and stroke-risk-reduction.

The initial mapping revealed that nurses have little influence on patients' previous OAC use or management. However, observation of the period after the initial mapping of historical AF patients showed that there was increased activity in stroke-risk scoring and nurse decisions about OAC use, particularly relating to DOACs. The involvement of nurses, which is attributable to the introduction of the OAC LES, has seen improvements in both OAC use and better stroke-risk awareness within the practice. However, the data was unable to illuminate how this was achieved in practice and therefore, requires further exploration.

4.9.1 Strengths and limitations.

This study was able to explore, not only the frequency of events, but also the quality of the events, and in so doing, is able to offer a more detailed explanation for OAC outcomes than what was previously described in the preceding literature review of GP initiated OAC use. The study was limited by the missing or inadequate data that was held within the GP records. This was particularly relevant to historical AF diagnoses; whereby mapping events became impossible when only Read-codes existed. The study is further limited due to being situated in only one, albeit large, general-practice. Therefore, the results found here may not be directly transferable to other practices. A final limitation is that patients were not directly examined, so there is likely clinician bias in the evidence available. For example, insider-researcher assumptions about GP-actions, in relation to OAC decisions and referrals, based upon the GP style of documentation, may be present. Furthermore, there were many

fields of missing data of historical AF patients' journeys that will have affected the overall analysis of the entire AF caseload here. Therefore, further research is required to explore specifically how the patient experienced the array of mapped pathways.

Who gets stroke prevention therapy? This study initially found that a total of 50.5% (150/297) of the AF-caseload were currently taking OAC, with a further 26.5% listed with potential CIS. This result is comparable to the findings of a recent cross-sectional study of 1857 general-practices in the UK (Cowan *et al* 2013) in which it was reported that, in patients with a $CHADS_2$ risk-score >2, the percentage treated with OAC was 54.7%, contraindicated in 9.2% and declined in 2.2%. The GPs here were initially more inclined to start aspirin, either as a first-line choice or as an interim measure, whilst awaiting requests for specialist advice and this has been acknowledged elsewhere. However, this approach has changed, considering the QOF changes up to 2017, and the reduction of APL was matched by the increased use of OAC. Previous studies have also noted that specialists are both more likely to prescribe OAC (Anderson *et al*. 2005) and have the greatest influence on OAC prescribing to which GPs are most likely to follow (Dinh *et al*. 2007). However, this study has also begun to see the emergence of new roles for general-practice through greater awareness of stroke-risk generated via the establishment of QOF-AF and the OAC LES. Previous studies have not explored this potential.

4.9.2 Implications for clinical practice/service delivery.

This study highlights the importance of understanding both the roles within general-practice in AF diagnosis, and OAC decisions, but also the existence of often complicated paths which the patients experience along the way. Emerging awareness of stroke-risk as seen through the increased use of $CHADS_2$ risk-scoring and a historic underuse of OAC in preference for GP prescribing of aspirin also showed that there was a need to alter GP approaches to, and systems of, AF management. There was no evidence relating to previous OAC use and management, which suggests that OAC use, was unrelated to PN activity. However, the AF patient-mapping between 2014 to 2017 further suggested that the emergence of new nursing roles in this general-practice, have also affected the rates of general-practice OAC use, which has not been identified in previous research relating to OAC management in general-practice settings.

4.9.3 Implications for research.

The implementation of both the OAC LES and changes to the QOF in relation to AF has possibly increased general-practice involvement in OAC processes. Furthermore, this increased participation in, and resultant use of OAC, is reflected by new nursing roles within the general-practice which have thus far not been explored in previous studies. However, this study was unable to explore the development or implementation of the OAC LES, or the nature of the nursing activity within it. This itself, may face barriers and facilitators, each with the potential of impacting upon OAC used, in general-practice, and will be explored in the next chapter.

Conclusion: Although the GPs are the overarching caseload managers for their practice population, how GPs form decisions about OAC use in AF patients remains unexplored in real-time. A further unknown factor on OAC decision-making is the roles that the other members of the health care team play. However, the advent of new roles in general-practice encouraged by QOF changes and LES participation may have an effect of the outcomes of OAC use in AF patients. For example, independent nurse prescribing changes the boundaries for who is responsible for prescribing medications. Furthermore, the introduction of an assistant practitioner, whose role includes the screening and identification of people at risk of chronic diseases, such as AF, within general-practice, means that staff beyond the GPs will have potential influence on the management of AF in general-practice.

Changes through greater awareness, financial incentives and the introduction of novel anticoagulants that may be easier to implement and manage will affect future decision-making and may improve outcomes for positive OAC decision-making and reduce decision treatment times. How the general-practice care teams develop these new leading roles in stroke-risk reduction, incorporate risk-assessment tools into their decision-making processes and demonstrate effectiveness in the management of OAC in AF patients, must also be investigated. To interpret the above findings in their context, further research is required to understand how GPs and their staff view stroke reduction strategies for people with AF in practice, both currently and for the future.

Chapter 5.

5.0 General-practice and Anticoagulation to Prevent Stroke (GAPS-2): An examination of OAC care changes in general-practice contextualized using the Normalization process theory: Identifying Context-Mechanism-Outcome configurations of OAC care.

The previous two chapters have highlighted the presence of several factors involving patient, clinician and organisational characteristics, which have previously affected the OAC use in general-practice. Furthermore, changes emphasising the GP role in, and focus upon, the importance of OAC in stroke prevention in AF patients, and have generated opportunities for general-practices to develop their services. These changes have the potential for overcoming several acknowledged barriers to OAC use.

This chapter presents an original contribution to knowledge by exploring the creation of new AF/OAC roles and services in a general-practice. Secondly, new knowledge is created about how new AF/OAC services evolve and become embedded within a general-practice. This new knowledge is significant for all general-practice staff that are, or could be, involved in evaluating, reorganising or designing new AF/OAC services.

This study will, therefore, explore how a large general-practice constructed and operationalized a new OAC service.

5.1 Aims: To formulate an explanation of OAC service development and embedding in a large general-practice.

Objectives:

To explore how OAC practice was introduced and how change affected practice in a large general-practice setting.

To identify the key roles required for this change of practice.

To describe the organisational and system factors that are required to enable OAC change of practice in the general-practice setting.

To identify specific factors, this promoted and hindered the embedding of OAC use, in a large general-practice.

To further develop the hypothesis that proposes how OAC can be operationalized effectively within a general-practice setting.

To analyse the components of a contemporary OAC service in general-practice.

5.2 Background.

General practice use of OAC for treating AF patients continues to be suboptimal, yet the previous literature review found that the roles within general practice involved in OAC management have been relatively unexplored. Instead, historic OAC management is assumed, largely associated with secondary-care. However, locally enhanced services (LES) which incorporate point-of-care testing (POCT) [13] of both International Normalised Ratio (INR) and computer-decision-support-system (CDSS), provide opportunities for general-practices to implement OAC management change.

GAPS-1 showed that the GP was involved in many aspects of AF detection/investigative phases of the patient's journey, whilst most of the ongoing management was the responsibility of secondary care clinics. However, since 2012, healthcare commissioning has endorsed reduced expenditure and reliance on expensive secondary care services. This placed increased focus on the role of primary care trusts (PCTs) and general-practice services (Department of Health 2002). Combining different incentives for GPs can act to promote changes in practice, which improves the quality and provision of care (McDonald *et al*. 2010), the most common of which are LESs (Marks *et al*. 2011). These incentives are designed into LESs, which are developed locally by PCTs in partnership with GPs and which focus upon the greatest local clinical needs (Marks *et al*. 2011). AF, when underpinned by key national guidance (NICE 2004), was thus an ideal clinical area, requiring both improvements in care and increasing GP engagement, and which was subsequently developed into a LES involving this study centre. Many different clinical LESs have been

[13] Point-of-care testing (PoCT) is defined as any test taken by or on behalf of the treating doctor on-site at the time of consultation that allows the test result to be used to make immediate decisions about patient treatment (Price C. and St John A. (2004) Point-of-Care Testing, 2nd edn. Washington DC: AACC Press).

studied previously. However, there is a dearth of evidence involving the improved outcomes associated with LESs and GP led OAC services (Kumar *et al*. 2014). Therefore, exploring an OAC LES constitutes a novel academic study area.

The OAC LES in this study was negotiated locally, between PCT commissioners and GPs, and resulted in four levels of service arrangements. These were voluntary agreements available at four service levels, and which all increased the GP involvement in OAC management of AF patients. The level-four agreement entailed GP provision of INR-testing using a POCT system, and the subsequent OAC dosing employing CDSS and ongoing management, including an annual review. Service remuneration was based upon assumptions about the treatment needs of "*stable AF patients*", including how many INR-tests were needed annually. However, fees were recompensed at a set rate per INR-test, whilst all the associated sundries were provided free to the practice. This meant that, initially, the general-practice benefited via payments for the numbers of INR-tests undertaken, but this was also new work that increased pressures on core/routine service provision. The level-four agreement adopted in this study centre was an entirely new service. As such, the staff had to learn about POCT, the CDSS, and develop new systems to operationalise the OAC service.

Point-of-care testing CDSS.

The LES, offering a range of participation levels, represented the different ways in which GPs could choose to engage with OAC management. This reflected the diversity of methods available to access blood, measure INR and undertake warfarin-dosing (Edgeworth & Coles 2010). The level 4 agreement in this setting involved the general-practice obtaining a blood sample by finger prick and using a POCT machine to measure the INR. Various examples of POCT machines have been evaluated against hospital systems for reliability and efficacy, with three UK examples proving to be acceptable for use, to suitably trained nurses in primary care (Murray *et al*. 1999). A systematic review, containing six trials relating to OAC management in general-practice, found increased patient satisfaction; increases in the percent of time spent within 0.5 INR from target, and cost savings with POCT (Gialamas *et al*. 2010). However, POCT are generally believed to be satisfactory, although inferior to laboratory tests, for the purposes of warfarin maintenance, but require robust protocols and policies to underpin their use (Wood 2019). These must include education and training

for non-laboratory staff including the use of internal and external quality assurance testing (Bonar *et al*. 2015), which were also components of the LES here. However, obtaining an INR measurement is only part of the level four agreement. The next step involved the dosing-decision and communicating this to the patient or carer, which then completed the patient contact episode. This would involve the use of a CDSS.

Various CDSS have been advocated to enable safe and efficient movement of OAC care into the community in the UK (Fitzmaurice *et al*. 1996; Vadher *et al*. 1997), which when combined with POCT, can be used effectively, even in novice primary care settings (Fitzmaurice *et al*. 2000). Thus, the INRstar program (Lumira Dx care solution 2015), an award winning CDSS for OAC use in primary care (Jones *et al*. 2005), was commissioned into this OAC LES. Training, for both the CDSS and POCT systems for practice staff, was provided free to the general-practice, as part of the OAC LES implementation. However, the effectiveness of CDSS, as an intervention for increasing OAC prescribing with GPs, is in doubt, as it raises the possibility of "*alert fatigue*", adding to the number of clinical alerts GPs already receive, during consultations (Ancker *et al*. 2017).

A list of potential singular and/or complex factors exist that may have potentially affected the uptake of this LES. Therefore, OAC use in general-practice constitutes a complex intervention. In keeping with Clarke and colleagues' (2013) definition of a complex intervention, as there was a considered range of individual parts that existed in the OAC management here. These included several factors, such as agency, LES implementation, POCT and CDSS, which collectively, encompassed contemporary GP-led OAC use.

The realist ontological philosophy, informed by an insider-researcher perspective, underpinned the overall methods used, as discussed in Chapter 3. As such, how actors (practice staff), the contexts and what mechanisms prevailed, were investigated to reveal the outcomes (CMO-configurations (Jagosh *et al*. 2015)) of the OAC LES in practice. However, it was hypothesized that CMOs changed, evolving over time, and with new outcomes emerging. So too, did the contexts in which the actors are then placed. Therefore, to undertake the CMO-analysis encompassing the nature in which the OAC LES was implemented in practice, a further theoretical framework was required. The Normalisation Process Theory (NPT) (May & Finch 2009) therefore, was key to how data collection could be mapped and analysed, in accordance with the linear-natured processes that eventually

led to the embedding of the new OAC LES in this practice. The resultant CMO-configurations, thus determined, would be demonstrable within a theoretical framework of processes developed specifically for enabling analysis and theory of complex interventions in practice (May & Finch 2009). The following section will describe the methods undertaken to investigate this complex intervention.

5.3 Methods.

GAPS-2 is a qualitative study which examined general-practice staff about the development, initiation, adaptation and eventual embedding, of an OAC LES. This study was also undertaken as previously indicated in Chapter 3, from the perspective of insider and researcher, undertaking scholarship whilst also employed as the single Nurse Clinician (NC) in this study setting.

Setting: A single general-practice, in the North of England with 5 full time General Practitioners (GPs), 3 part time (Practice Nurses (PNs), 1 Health Care Assistant (HCA) and 1 Nurse Clinician (NC). Practice population of 14134 patients.

Ethical approval was granted by University Ethics Committee, (BuSHEthics Committee Reference Number: BuSH 106, 0803/2013); NRES was not required. A more detailed description of this is presented in section 3.3 (P.91).
Access: The research degree student is also employed as an NC in the study setting. The student had permission in principle for access to the study setting in writing from the Practice-Manager (PM) and lead GP.

Consent: All 5 GP-partners, all 5 nurses and the PM, were included after providing formal written consent.

Methods: Undertake staff interviews. The NPT was used as a framework to develop interview questions around the use of OAC in this general-practice.

Practice staff were interviewed about their experiences about OAC in this general-practice, between October and December 2013. All 5 GPs, 3 PNs, 1 HCA and the PM were invited to participate. I had outlined the awareness of the research project in a seminar, discussing ethical concerns, gaining formal consent and conducting digitally-recorded interviews. Arrangements for interviews were negotiated with individual staff and occurred at the study

centre. The aim of the interviews was to assess attitudes, beliefs, values and understanding of both the role of the staffs (Carlson *et al.* 2007) in stroke-risk reduction and OAC management, and effects of the other competing responsibilities that staff have in making decisions about OAC.

Data collection: Data was collected by digital-recording and then transcribed verbatim, using data collection sheets, based upon the fields of the NPT framework.

Data analysis: Data was manually coded from the interview transcripts into the NPT model using Excel spreadsheets. Once the interview data was completely coded into the NPT framework, a secondary-phase analysis was undertaken involving CMO-configurations. This phase of the analysis enabled the generation of themes, which could be used to develop evidence of potential factors, which were facilitating or preventing OAC use here. These factors would then be used to refute or clarify the previously stated logic model. Samples of qualitative data were used within the research team to allow for internal validity of data coding and discussion.

5.4 Results.

A summary of the findings from the initial analysis, are reported by the key constructs and related components and are defined in Figure 6 (P. 86). A summary of the key factors that emerged from the NPT constructs (Table 40), depicts multiple elements relating to agency, systems, organisational and cultural factors, which will be described in context, over the following pages.

Table 40. NPT: A summary of factors relating to OAC use arising from the constructs and components.

Coherence (Sense-making work).			
Differentiation. (Understanding the difference between old and new practices) • A limited GP role. • No formal OAC practice. • GP refers to cardiology for OAC decisions. • Cardiology referrals were dependent upon patient age. • Warfarin care too complex for general-practice. • GP concerns around prescribing anticoagulants and other medications. • GPs are prescribing blind. • Multiple warfarin clinic providers. • Critical incidents and practice complaints. • The patients' experience. • No previous OAC role for nurses. • Nurses lacked awareness about the association of AF and stroke.	**Communal specification.** (Shared understanding) • The Commissioner role. • Internal practice meetings organised to promote change. • Financial opportunity. • GPs decide roles. • GP – Nurse paternalistic relationship. • Nurse assumptions about GP-motives.	**Individual specification.** (Individual understanding roles) • Nurses assess personal risk/ benefits of undertaking new role. • Funding and the GP. • Nurses and fear. • Assumptions about OAC expert role. • The simplicity of OAC nursing processes explained. • Opportunity for HCA role development. • Initial OAC training.	**Internalization.** (value, benefits of practices new and old) • The quality of patient OAC care. • GP funding concerns. • Personal role impact of OAC change.

Cognitive Participation. (Relational work)			
Initiation. (Key people work to implement practice) • Defining OAC role.	**Enrolment.** (Organising and encouraging staff) • Peer support versus peer-pressure. • Learning and developing OAC skills.	**Legitimation.** (Staff believe in the new practice) • Roles and conflict. • Developing awareness of the OAC processes. • Trusting the GP OAC advice. • GP and quality of care.	**Activation.** (Defining roles and responsibilities) • Nursing collaboration. • Nurse training in OAC.

Collective Action. (Operationalization)			
Interactional Workability. (Practicalities of working together) • The GPs offer themselves as advisors but fail to engage in CDSS as first agreed. • The nurses form alternative support methods.	**Relational Integration.** (knowledge and experience) • Clinical support for nurses. • GP-availability. • Trusting clinician advice about using CDSS. • Nursing teamwork supporting each other. • Nursing leadership emerges. • GP safety concerns. • GP role in AF management. • GPs using risk-scoring.	**Skill set Workability.** (Roles and expectations) • Nurse-awareness of GP roles. • GP-awareness of nurse-roles.	**Contextual Integration.** (Resources) • New OAC procedures (POCT, CDSS). • QOF impacts nurse consultations. • Adapting POCT consultations. • Minimizing MDT burden. • Discussing stroke-risk. • GP OAC decisions. • GPs managing existing stroke-risk. • In-house expertise.

Reflexive Monitoring. (Reviewing)			
Systematization. (collecting review data) • Adversity and OAC practice. • TTIR data.	**Communal appraisal.** (Group evaluation) • Time demands on OAC practice.	**Individual appraisal.** (Self-evaluation) • Improvements in OAC quality of care. • Protecting practice funding. • Unintended consequences of the OAC LES.	**Reconfiguration.** (Accepting or redefining practices) • Increased AF case-finding. • OAC promoted.

5.4.1 Coherence.

In this initial phase of the OAC changes, staff at the surgery, had to first realise the need and understand their part in any future change, which in the NPT, and is referred to as "*coherence*". According to May *et al*. (2015):

> "…*Coherence is the sense-making work that people do individually and collectively when they are faced with the problem of operationalizing some set of practices*."

Figure 29. Differentiation - Contextual factors affecting GP & nurse OAC practice.

Roles:

A) GPs had no direct role in OAC decisions.
B) The GPs role was to prescribe repeat prescriptions of OAC on request.
C) The GP had no role in managing AF or stroke-risk.
D) The GPs role is to decide when to refer AF patients for decisions about treatments and management.
E) Nurses had no role in AF or OAC management.
F) The nurse's role in the OAC process was limited to undertaking venous sampling previously.

Practice:

G) All OAC management was undertaken externally from the GP.
H) There is no agreed or formalised OAC practice for AF stroke-risk-reduction.
I) All AF patients were referred to secondary-care for onward management.
J) Referral decisions were guided by assumptions based on the patient's age.
K) The GPs were prescribing OAC "*blindly*".
L) GPs treated patients taking OAC.
M) Multiple providers of OAC services existed locally.
N) Stroke-care and OAC were done in hospital.

Processes:

O) Patients requested repeat prescriptions of warfarin from the general-practice.
P) There were no systems in place to manage AF patients at risk of stroke.
Q) The GP might not refer all AF patients for decisions about OAC use.
R) The GPs required anticoagulation information that was held externally to them.
S) There were no systems in place to determine or communicate the quality of OAC external to the general-practice.
T) Blood was taken and sent to the hospital for INR-testing and management.
U) Stroke patients were reviewed; this did not involve AF assessment.

Differentiation encompassed several contextual factors relative to the GPs and nurses (Figure 29). The key background contextual factor for GPs was a previously limited role in assessing AF patients and managing OAC treatments. Instead, the GPs' main role focused upon the provision of OAC prescriptions (Figure 29).

In relation to patients taking warfarin, GP4 explained that:

> GP4 (21-27) "[historically]…*warfarin was literally under the anticoagulation clinic and the GP's involvement was just really to give a prescription and to, if suddenly you're phoned through INR then you would you know admit them or whatever needed doing on that day.*"

Limited experience of dealing with abnormal INR results was perhaps, only an occasional role, although another GP had no experience of managing warfarin in the practice setting:

> GP3 (143-148) "…*I can't honestly say that I remember ever being in a situation where I've had to, to, to manage it in-house*."

Consequently, the previous GP role became mechanistic in creating a status quo, whereby the GPs were not proactive around OAC. This point was also exemplified by GP4, as he explained about new AF patients in his care:

> GP4 (399) "…*in the past somebody with stable AF, you might have automatically just devolved all thoughts about what you're gonna do for that patient and just referred them to cardiology straight away*."

As the GPs had no recognised role in managing AF or stroke-risk, common practice involved the onward referral of AF patients to secondary care for OAC management. The subsequent relational-mechanism, promoted a culture of practice that cardiologists managed AF decision-making, underpinned by GP-agency believing it was not their role to make OAC decisions. The subsequent outcomes were to potentiate and reinforce a lack of GP-involvement in this area.

Of greater concern, it was also found, that many AF patients may not have even been referred, due to GP beliefs about the dangers of OAC and increasing age, as GP2 outlined:

> GP2 (119-130) "…[historically] *the feeling was the younger AF's were the more important ones to pick up and potentially treat and the older ones and it's back to*

this issue of how dangerous warfarin is or isn't, … initially you'd have made the decision and frequently, …you probably just noted it was AF as opposed to doing much more about it"

This supports the notion, that GPs, have previously, either undervalued the stroke-risk, or overvalued the harmful risks, associated with aging AF patients, or alternatively, placing greater value on treating younger AF patients more proactively. As such, these GP decisions were mechanistic in maintaining an underuse of OAC, with the majority of undertreated patients, being older within this general-practice.

However, if the GP did decide on the need for OAC, this would always be organised via a secondary care setting, as warfarinization was believed to be too complex an undertaking for general-practice, as GP1 exclaimed:

GP1 "…[historically] *we would very rarely anticoagulate AF patients, we'd never particularly associated them with, well I think we did associate them probably at risk of stroke, but warfarinization was actually so difficult I suppose that you know there would always be the hospital*."

Therefore, GP agency was also mechanistic in reducing the likelihood, which GPs would ever engage in warfarin management.

However, historically, the main concern for the GPs at the start of this change process, related to having knowledge about warfarin management, when prescribing medications to patient taking warfarin:

GP5 (89-92) "*…if you prescribed warfarin you didn't always know that they were having their INR's checked, and that they were on target*."

As all OAC management practice was undertaken externally from the surgery, GPs found difficulty with the processes around accessing OAC information, which was held externally to them. This was further complicated, by processes concerning a lack of systems in place to determine or communicate the quality of OAC, external to the general-practice. This

created several opportunistic mechanisms for the GPs, which produced positive outcomes for OAC change.

Firstly, the structure and quality of usual OAC practice, was deemed poor by the GPs. This was typified by inadequate OAC management communications, such that, the GPs had no knowledge of management details of OAC and INR-testing.

However, these concerns related more to the GPs' roles in treating other conditions in patients taking warfarin, rather than understanding the quality of OAC per-say. A lack of Information about INR-testing and warfarin-dosing resulted in GP-agency of prescribing blindly:

> GP3 (263-281) "…*sometimes when you see a patient you don't always have the blood results to hand and the patients don't always know who's looking after, even though, they're having these phone calls from the anticoag service they still sometimes think that we're dealing with it and it does make you look a bit daft when you don't know that they've had discussions about the recent INR-results, …it can put you in a tricky position sometimes… you're not really entirely sure whether someone's even been monitored because you know they may have dementia or something of that nature…in my opinion it's still a bit messy when we're not dealing with all the medication*."

Therefore, for GP3, safety concerns, relating to the actor's role in prescribing, became mechanistic in producing motivation for OAC change in this general-practice.

A further contextual factor arose, when trying to access the INR result information, as staff experienced occasional difficulties trying to establish, if and at what location, AF patients were being monitored, as the PM explained:

> Practice Manager (17-20) "…*GPs were prescribing and had no idea whether patients were being monitored or not" Practice Manager (91-93) "…quite often we didn't*

know, cos people had been on warfarin that long we didn't even know which hospital they were under."

The presence, of multiple local OAC service providers, thus constituted a structure/resource mechanism for staff, that resulted in the shaping of positive attitudes towards supporting and informing the need for OAC change.

The context, of a restricted GP prescribing role in OAC medication, and the lack of knowledge about individual patient warfarin management, left both patients and the general-practice, vulnerable to medication errors as the PM described:

Practice Manager (57-64) "…*we had a complaint a couple of years ago, quite a serious complaint which involved a warfarin patient…who actually overdosed on warfarin and we weren't aware that he wasn't being monitored, we were assuming that he was being monitored and he wasn't*."

Here, the PM reiterated the problems with hospital-to-GP communications, about OAC management and the dangers relating to warfarin use. Furthermore, the PM also describes a culture mechanism, whereby, complaints and other critical incidents were used as a practice development tool, to advance the notion for the need to change OAC practice.

Finally, building upon the worst possible patient experience of OAC management, the GPs also considered the previous contextual factors about the patients' routine experiences of the quality of existent OAC systems. This was particularly about process factors, concerning INR-testing and dosing management. For example, GP5 also elucidated, that the system was not straight forward for users:

GP5 (100-106) "…*it was a bit haphazard …the old system…where the warfarin book had to go up to the hospital and then somebody in the hospital had to decide what dose…there was a lot of to-ing and fro-ing*. "

However, the patient's experience, was perhaps best expressed and represented here, by the PM, who had direct experience of the OAC systems, and for whom it is argued, greatly influenced the GPs in discussions about OAC change:

> Practice Manager (243-253) "*…my mother's one of them [laughs]* [warfarin patient] *…she'd have to go down to the centre and have to go and wait in a queue everybody turned up at the same time, …they test your blood, you have to leave your book, you had to go home then you had to sit and wait in if they'd ring you. If you didn't get a phone call you thought well it's not, nothing major, and then you'd get your book back in post two, three, four days later*."

The PM agency about patient routine OAC experiences became mechanistic in enhancing positive OAC outcomes, by driving changing attitudes towards OAC management in this general-practice, and thus informing the need for change.

However, for the practice-nurses, based upon their own experiences, different background factors existed, that prevented them in understanding the need for practice change. Firstly, the nurses had no previous direct role with AF patients or in OAC management, apart from undertaking venous sampling, as N3 explained:

> N3 (120-129) "*…the only knowledge I had was occasionally…I would get a patient to come for a warfarin the blood test the INR and take their yellow book off them, take the sample blood out of their arm, put it in with the yellow book into the bag and send it off to the hospital, that was it, no knowledge about dosing, no knowledge about any conditions…or what even warfarin was, it was just another medication that I didn't really have much to do with*."

As such, the PN's lack of awareness concerning OAC management, the previous problems associated with warfarin management, how it affected patients and the practice, were all mechanistic in preventing them from investing in the notion of the need for OAC change.

The nurses also seemed unaware of the role of warfarin and the importance of its use in stroke-prevention, and therefore, envisaged no role for practice-nurses. For example, N4 reported:

> N4 (54-61) "...*we used to do reviews for, …stroke patients. We never really had, put the two together the warfarin and the strokes as such…we did have stroke patients that were on warfarin, but not all stroke patients were, no it was just…something that wasn't anything to do with us, it was all dealt with at the hospital*."

Figure 30. Differentiation - Mechanisms affecting GP & nurse OAC practice.

Mechanisms:

A) (Role) GPs had no direct role in OAC decisions.
B) (Relational) There was a culture of expectation that cardiologists managed AF decision-making).
C) (Agency) GPs believed it was not their role to make OAC decisions.
D) (Culture [agency]) Acting upon AF was only important for younger patients.
E) (Culture [agency]) Warfarin is dangerous.
F) (Agency) GPs believed warfarinization to be too complex for primary-care.
G) (Structure [practice]) Poorly perceived OAC management and communication was usual, accepted practice.
H) (Structure [practice]) The GP had no knowledge of management details of warfarin testing.
I) (Culture [agency]) Existing systems were experienced as being of poor quality.
J) (Structure [resources]) Multiple providers of OAC services existed locally.
K) (Culture [structure]) Critical incidents shape future practice.
L) (Agency [belief]) Prior OAC systems were inadequate for the GPs' needs.
M) (Agency [belief]) There are safety concerns relating to the actor's role in OAC.
N) (Agency [belief]) Personal negative experiences of patient OAC systems.
O) (Cultural [structure]) PNs lacked OAC management awareness & experience.
P) (Culture [roles]) There was a lack of clinical awareness of the association between AF and stroke.
Q) (Agency [belief]) Nurses believed that OAC care should not involve them.

Therefore, the background factors that concerned perceptions about secondary care based OAC practice" and the non-inclusion of AF in stroke-risk monitoring "processes", underpinned mechanisms that affected nurses. Firstly, a nursing "culture" mechanism, reflecting a lack of clinical awareness of the association between AF and stroke, was evident. This finding is of particular relevance as it indicated the uncovering of potentially harmful practice with non-engagement due to a lack of understanding of the link between AF and stroke risk. Secondly, nurses believed that OAC care should not involve them. Both

factors were mechanistic in producing negative outcomes for OAC change, by creating negative practice-nurse perception, regarding the need for OAC change.

Differentiation thus reflected, the contrasting clinician experiences, of how OAC affected their individual clinical roles, which were expressed as mechanisms (Figure 30). These differing perspectives immediately created divisions, in both the nature of the mechanisms and outcomes for the need for OAC change here, which formed the next NPT component, communal specification.

According to May *et al*. (2015), in the coherence construct:

> "…*Sense-making relies on people working together to build a shared understanding of the aims, objectives, and expected benefits of a set of practices sense-making, thus termed "Communal specification*."

Figure 31. Communal specification - Contextual factors affecting OAC care.

Roles:

A) GPs have managerial responsibilities.
B) Nurses had no role in AF or OAC management.

Practice:

C) The practice has a regular set meeting-schedule for partners.
D) All OAC management was undertaken externally from the GP.

Processes:

E) Commissioners wanted localized, cost-effective services.
F) There were no systems in place to manage AF patients taking warfarin or at risk of stroke.

The previous component illustrated that nurses had very little experience of, or current input with AF or OAC, resulting in apparent mechanisms that produced neutral to negative outcomes for the need to change practice. However, the GPs, who had different responsibilities and who were negatively affected by the previous systems, had different opinions towards the quality and safety of the services provided. Secondly, the GPs also had employer responsibilities which had to be balanced against financial constraints within the NHS.

Several factors were found, illustrating how the staff built a shared understanding of the new project and OAC care changes. These were situated, within contextual factors (Figure

31). These included the influence of the commissioner role, the importance of financial opportunity, The GP in deciding nursing roles, the GP-nurse paternalistic relationship and nurse assumptions about GP motives for change.

Firstly, building a sense-making consensus, required the initial awareness of the possibility, that OAC change could occur, and this was prompted by invitations from commissioners:

> GP4 (202-207) "…*initially the people who were really positive about it were…the commissioning group because they were trying to reduce costs,….they were asking practices to do it, and then our practice manager was really positive about it, she thought look we can, we can do this, we can do it as well or if not better than them and make some money at the same time*."

The commissioners' aims, created a process background factor, which was facilitated via the practice's partners-meetings. Both factors created the opportunities for new mechanisms that produced positive outcomes for the OAC change.

Firstly, a culture mechanism, that acknowledged the presence of economic processes and pressures affecting the general-practice, was acknowledged by the PM, who was always looking to manage the financial aspects of the practice. This LES was then regarded positively and envisaged to be a method for balancing practice incomes.

As part of these early discussions with commissioners, the GPs discussed both the feasibility and who may undertake the LES in practice, as explained by GP2:

> GP2 (337) "…*you tend to get a document sent out from the PCT about one of these services saying are you interested in doing this or not, an, and that is the choice of the practice, so that's the medical decision, and then the other part of that would be who is going to do this, who is appropriate to do this in terms of medical, or nursing and then is, is one of the doctors going to take an, a responsibility or an overview for it.*"

Contextually, the GPs' employment/managerial responsibilities, aligned to the commissioners' desires, to localize and produce cost-effective OAC services. Therefore, the GPs were presented with at least two options, which were positive mechanisms. Firstly, opportunities for OAC change depended upon commissioner encouragement. Secondly, GP agency only became active, when it was believed that adequate resources would be available. In this example, both mechanisms led to a positive outcome which encouraged and enabled further consensus building for the need for OAC change. Consensus occurred first between the GPs, who would then use it to "*sell it to the nurses*."

The GP-managerial role gave them a power advantage over the nurses who they employed, which resulted in a paternalistic-relationship between GPs and nurses. Communicating ideas for change was usually undertaken in formalised regular practice meetings between GPs first, then to *sell it* (sic) to the rest of the team.

Practice meetings were a formalised contextual factor here, that were also considered to be a culture mechanism, employed by the GPs, to encourage a consensus for the need for change with other practice staff. Furthermore, it was from this mechanism, that two further mechanisms became evident. Firstly, leadership roles occurred at different stages of the OAC change, reflecting a structure mechanism. Secondly, there was a genuine value placed on leadership as it occurred, that resulted in positive outcomes. For example, the leaders could positively communicate the need for OAC change to other members of the practice team.

However, although the use of formalised meetings for GPs was intended to be mechanistic of consensus building, attendance alone was no guarantee of building an agreement, especially when previous meetings hadn't included the nurses, whose workload and role, the proposed OAC change would later affect.

> N2 (42-43, 55-57) "…*no they had several meetings on a Monday, I do remember that where the penny was dropped, …where we'll be doing the warfarin clinics, …the three of us go a bit, oh my God what does that involve? ……at first, they* [nurses] *were all up in arms at, I think more the fact that we were frightened by the name warfarin and what it entailed*."

N2, succinctly described above one meeting used as a tool for instruction not discussion. For the nurses, who worked within three key background contextual factors, with no previous role or experience with warfarin, the suggestion of role-change produced new mechanisms that shaped negative outcomes for OAC change.

These included, a key nursing belief, affecting agency and concerning a fear of what OAC practice entailed, most likely, the result of the nurse's absence and involvement in the initial planning meetings. Both factors were mechanistic in producing a lack of nurse-awareness for the need to try and change OAC practices. Therefore, the use of formalised team meetings was perceived as an announcement platform for the GPs, rather than an educational event for nurses, as N2 exclaimed:

> N2 (58-60) "...*Gradually we really without anything we, we it was enforced on us, we had no choice, we just had to do it*."

Instead, the meetings led to negative perceptual outcomes, exposing further mechanisms, also with negative connotations. For example, the nurses believed that there was a paternalistic GP-Nurse relationship, concerning OAC changes in practice, underpinned by a relational-mechanism, whereby, the GPs expected the nurses to assume the new OAC role without question. This ultimately, triggered a further relational-mechanism regarding how the two clinical groups negatively envisaged each other. The culmination of these factors led the nurses to pronounce that their agency in OAC care at this stage, should not involve them.

This lack of awareness and oversight surrounding the need for OAC change, developed into a toxic resistance by the nurses, whereby N1 explained:

> N1 (27-33) "*…it was an enhanced, an enhanced service was why we were doing it I believe…well we, …were told that we were going to be doing it, not we were asked whether we wanted to do it or wanted to be involved in it*."

The nursing belief about assumptions concerning their role in relation to GP-earnings was further mechanistic in creating resistance and resentment for the nurses changing their practice to include OAC care.

In summary, of the communal specification component, several mechanisms were identified that affected both GP and nurse engagement in OAC change (Figure 32).

Figure 32. Communal specification - Mechanisms affecting GPs & nurses.

A) (Culture [process]) Opportunities for change are sometimes dependent on external sources alone.
B) (Agency [belief]) Service continuation/expansion decisions rely on adequate and the right resources.
C) (Culture [processes]) There are economic processes and pressures internally & externally affecting the general-practice.
D) (Culture [practices]) Practice meetings are a device for discussing change.
E) (Structures [practice]) Leadership-roles: various leader-roles emerged at different stages and levels of implementation.
F) (Relational) Leadership is valued.
G) (Agency [belief]) Fear of OAC practice.
H) (Relational) The nurses were not involved in the initial planning meetings.
I) (Culture [agency]) There is a paternalistic GP-Nurse relationship related to change of practice.
J) (Culture [relational]) There were negative conflicting attitudes between the GPs and the nurses towards each other in relation to changes of practice.
K) (Relational) The GPs expect the nurses to assume the new role without question.
L) (Agency) [belief]) Nurses believed that OAC care should not involve them.
M) (Culture [agency]) Nurses assume they are there to make the GPs money.

The GPs wanted change, and were confident in their assumptions, that the practice-nurses should and would, undertake this new role. But they were also fearful of the impact on their roles and the wider core duties of the practice. However, the nurses, whose background factors included them having no experience of OAC management, were presented with the notion of change, via mechanisms that resulted in negative outcomes for OAC change. Only the prevailing leadership roles, which emerged out of these meetings, could be viewed as a positive mechanism moving forward. For individual nurses, this was considered inadequate reasons for change, as discussed next as individual specification.

The next sub-theme in the Coherence construct of the NPT is Individual specification. According to May *et al*. (2015), in the coherence construct:

> "…*Sense-making has an individual component too. Here participants in coherence work need to do things that will help them understand their specific tasks and*

responsibilities around a set of practices", which May and colleagues (2015) termed "Individual specification."

Individual specification included how nurses assessed the risks and benefits to undertaking this new OAC role, funding and the GP, nurses' fear, beliefs about warfarin expertise, GP-explanations of OAC processes, opportunity for HCA development and OAC training. These findings were underpinned by specific contextual factors (Figure 33).

Figure 33. Individual specification - Contextual factors affecting nurses.

Roles:

A) GPs allocate nursing roles.
B) Nurses had no role in AF or OAC management.
C) HCA role is developed.

Practices:

D) All OAC management was undertaken externally from the GP.

Firstly, for the nurses, understanding their roles in, and the value assigned to the OAC work, remained grounded in beliefs that the OAC changes were only motivated by the financial benefits for the GPs, as N2 explained:

N2 (103-110) "…*I think that obviously the pennies were a good thing for the GPs wasn't it, because if it meant bringing more money in, I can't see where we'd gain from that in…any aspect other than we've took on another role yet again*."

Based upon the previously documented context of ever-changing, financial pressures on the surgery, and the new contextual factor that GPs assume and allocate nursing duties, previously identified culture and agency mechanisms resulted in an aversion to change generally.

The lack of GP-responses relating to individual specification towards the OAC change supported the nurses' belief, that the change was motivated by practice funding. However, the nurses never referred to, or showed awareness about, the GPs' non-clinical roles as possible motivations for eliciting a rationale about the financial gains associated with undertaking the OAC LES, as suggested by GP3:

GP3 (445-464) *"…it's a financial incentive, and obviously when we see a LES like that it's sort of adding some security to next year from a,…point of view of an income stream…with all the cuts that are being made…nothing's getting any cheaper…bills go up every year and so the global sum that we get…is kind of coming down indirectly because of inflation and so I think by having the LES's and the elements of the QOF it gives you another way of trying to recoup the costs that you're bearing in other ways. So although you may not be making any money out of it you, you're still keeping your head above water and I think that's the way most of us look at it, and that's why we try to do most of the LES's and the DES's when we can, because it's basically protect, protecting people's jobs and keeping the service running."*

However, there were no GP-responses, that explained how the GPs themselves, would be changing their practice towards the OAC change. Instead, it was expected, that the nurses would simply lead the OAC changes and care. Therefore, for the GPs, the presence of economic processes and pressures catalysed the beliefs about service continuation/expansion decisions being reliant upon adequate funding, both found to be mechanistic-factors, within individual specification. Thus, for the GPs, the financial aspects were viewed via a practice-specific lens, rather than from personal financial gains. The resulting outcomes were to pursue OAC practice change. Indeed, this was part of their role in it.

Fear arose in the nurses, once the realization that a new OAC role involving them, was going to occur. Based upon no previous OAC nursing role context, N1 explained:

N1 (34-36) "…*I personally found it quite a scary thing because of the limited or very little knowledge I had about it, so yeah I was apprehensive*."

Although, previously considered as contextual factors, nursing inexperience had also created role change anxiety, that later strengthened each other's motivation to resist engagement in the new OAC change.

It was also apparent, that this fear was based around a belief that OAC ought to be managed by experts, as N4 outlined:

N4 (30-36) *"...I discussed with* [NC] *at the time that you've got specialist nurses in hospitals who have trained for three years and know everything there is to know about warfarin, and we're being asked to do something that we know nothing about, so I wasn't very happy at all*."

Figure 34. Individual specification - Mechanisms affecting nurses in OAC care.

A) (Culture [agency]) Warfarin management viewed as a specialised area of practice.
B) (Agency [belief]) Nurses believed that OAC care should not involve them.
C) (Agency [belief]) The nurse had no knowledge required to undertake the role leading to heightened anxiety.
D) (Agency [belief]) There was a fear of what Warfarin management entailed.
E) (Structure [practice]) The GP promises to take full responsibility for warfarin-dosing queries and decisions.
F) (Agency [belief]) OAC change was an opportunity to learn and grow job satisfaction.
G) (Structure [practice]) The HCA role is developed to include Warfarin management via the near-patient testing system.
H) (Structure [practice]) The HCA becomes a focal leader for the new OAC service.
I) (Agency [belief]) OAC training creates awareness of patient need.
J) (Relational) Undertaking OAC training and role leads to awareness to develop further knowledge.

Contextually, the lack of nursing roles in AF or OAC management and OAC practices, which where all undertaken externally from the site, resulted in new negatively reinforcing mechanisms (Figure 34). These mechanisms were based around nursing fear-based beliefs that warfarin management was viewed as a specialised area of practice and should not involve them, because they had no knowledge, required to undertake the role. Each of these mechanisms created barriers for the nurses in enabling their understanding, about how they would develop their work and responsibilities, around the OAC practice.

However, from the nurses' perspectives, the GPs did not visualise these concerns the same, for them, the process was much simpler, and involved little effort on behalf of the nurses to perform, as explained by N3:

N3 (68-81) "*…it was Doctor xxx [03:11] that initially spoke to me about it, he didn't explain too much just the basics instead of taking, …warfarin patients for a blood test it was just gonna be a basic finger prick and a system on the computer would do all*

the dosing, and if there was any concerns to go and speak to them, so they…sold it to me as very straightforward, very basic, …which didn't really sit too well to be, making those clinical decisions without extra support, you know if it was just me on my own in the room with the patients."

In this example, the GP had portrayed a simplistic, new OAC system to the nurse, by way of a new structure mechanism, of the GP assuming responsibility for warfarin-dosing, which encouraged the HCA to consider a new OAC role.

Once the PNs had decided that warfarin management was not a role for them, the idea of a practice development role for the HCA, emerged as a key contextual factor. Firstly, the new role was viewed opportunistically, as a means of personal development:

N3 (304-316) *"… [the benefit of acting] as something new to learn, it was a lot of new things to learn…like what's atrial fibrillation and what's warfarin. I got to meet with the same sort of patients more regularly as well, you create more of a rapport with them in a way, you get to know them quite well, and I got to learn, got to do something different to what I was doing."*

Here, the HCA's attitude towards learning, created the mechanism that the OAC change, could provide the opportunity to grow her clinical practice and increase work satisfaction, which would begin, by experiencing external training about OAC, as clarified by N3:

N3 (89-96) "…*so I think they* [the GPs] *put it out there, …it was mentioned to the nurses that someone was going to start it and I got the impression it was gonna be the nurses and they weren't too keen on it and then I got mentioned …and then I was gonna go and do some training and they were gonna in, be trained afterwards*."

The HCA role itself was also new in this practice. So, it was yet to be fully defined by the GPs. It also represented a new structure mechanism, which would result in a positive outcome for the OAC practice, by enabling new capacity in the appointment systems.

The new role also created a new structure mechanism, regarding service leadership role. This further enabled a focal point, for the other resistant nurses to assess how they may or may not later, be recruited into the OAC systems, a theme best expressed through the need to undertake formalized OAC management training, by N3:

> N3 (166-176) "…*I went down to Birmingham for the training it was very, basic training. They basically taught you how to use the machines, they didn't go into a lot of the conditions, so even then I don't think I wasn't fully prepared even after that training…it was 'this is how you use a machine, this is how you get the blood and this is how you put it through the computer', but that, that tells you how to do the task but it doesn't explain why you're doing it and why you're giving the patient that dose*."

Although the key contextual factor for N3, was one of role (HCA role is developed), this also created opportunities for further key-mechanisms, which enabled N3, to develop individual specification, namely, understanding and responsibilities around the OAC practice. Firstly, formal training enabled a growing awareness of patients' needs and activated an awareness, to develop further knowledge. Both factors were mechanistic in encouraging OAC practice.

Interestingly, none of the GPs ever underwent any of this same training that they themselves had encouraged. The new awareness, gained from training, highlighted for N3 above, and the NC (not stated), how the OAC could be of value, in what is described next, as internalization.

The next sub theme in the Coherence construct of the NPT was internalization. According to May *et al*. (2015), in the coherence construct:

> "…*sense-making involves people in work that is about understanding the value, benefits and importance of a set of practices", which May and colleagues' term "Internalization*."

Internalization, underpinned by four key contextual aspects (Figure 35), was represented by factors such as, the quality of patient care, existing general-practice-funding concerns and person role impact of OAC change.

Figure 35. Internalization - Contextual factors affecting OAC care.

Role:

A) The GP has no role in the LES system.
B) The NC assumes an OAC leadership role.

Practice:

C) There are frequent requests for general-practice to expand their services.
D) There was great demand for access to GP services.

Firstly, there was a perception about the benefits to patients' quality of OAC care, which resulted in a mechanism, now shared by both the nurses and GPs. These perceptions created positive outcomes for OAC change, as iterated by both N1 and GP1:

> N1 (121-132) "…*I can see that obviously it's better for some patients, it's much more easier for them to attend the surgery than maybe if they were trooping up and down to the hospital and you know the books, the yellow book going off waiting for it to come back and things, it, it does make it easier*."

> GP1 (107) "…*it's so far away* [the hospital]…*it's not patient friendly they're often elderly, frail, not very mobile and they go and sit in these warfarin clinics remotely, whereas now it's you know closer to home, much more personal…on a one-to-one, so I think anybody comes here knows everybody who does it, …and then dosed immediately…whereas there they were sent home to be dosed by telephone later on*."

Several new mechanisms arose (Figure 36) including clinician-beliefs about the existing quality of services and how patients may benefit from more localised, patient-focused care. These mechanisms resulted in positive outcomes, which encouraged the uptake of the OAC LES here.

However, a second set of themes relating to the OAC LES, were also apparent. These were linked to resources and included, general-practice-funding concerns and impacts of OAC changes on individual clinician practice. These factors generated mechanisms that led to indifferent or negative outcomes for OAC change here.

In the first example, GP3 has no active role in the LES-system and there are frequent pressures to take on new services provided by other clinicians:

> GP3 (331-340) "…*there's always somebody else to do it you know…cos you've got…the recent changes with the psychiatric drugs where they're trying to drop…an extra work load on us and it just seems like we're getting an extra work load from all sorts of different directions, and not necessarily the right funding to accommodate it*."

The resultant cultural mechanism represented the presence of changing clinical priorities, which came from changes in funding. However, GP agency, concerning beliefs about clinical dumping, was also mechanistic in producing attitudes that might not always be supportive of the OAC changes.

These views were further expanded to include, how the OAC service might itself affect individual GP's practice, given that the NC was now assumed to be supporting the HCA in running it, as GP3 explained:

> GP3 (350-353) "…*I think we all value XXX's time as clinician because XXX, does see a lot of the things that we would see, and obviously if those appointments are being taken up*."

Here, in context, the NC's role was to support the HCA to deliver the OAC LES. Thus, a new relational mechanism emerged, that potentially affected the daily workload of the GP, by reducing the level of routine patient access, which the NC previously provided. The GP's reticence that the intended staff hadn't taken on the new OAC role and instead, an advanced-nursing role had become compromised challenged his belief in the value of

undertaking OAC in-house. However, for this GP, the competing clinical priorities in the practice were more important than developing new services, as GP3 further stated:

> GP3 (323-332) "*…I've never really looked properly at a LES cos…I've not had the desire to at the moment, but you know we're pushed for appointments every day as it is, if there's another service there that will do it you know there's an argument there that are we better off just meeting the, the demand of people who want to be seen rather than trying to take on another service that it, there's always somebody else to do it you know*."

For this GP, contextually high demands for access to general-practice-services, created both important agency key beliefs about the importance of providing access, and the belief that creating a new OAC service could affect clinical capacity and thus, access to services. These beliefs were mechanistic in causing negative responses, which resulted in devaluation and a reluctance to support the OAC change.

Figure 36. Internalization - Mechanisms affecting OAC care.

A) (Culture [agency]) Near-patient testing is good.
B) (Culture [agency]) Existing systems were experienced as being of poor quality.
C) (Culture [agency]) Concerns about quality of care encouraged practice to change.
D) (Agency [belief]) There is a belief of improved quality of patient care available for patients.
E) (Culture [structure]) There are changing clinical priorities, which come from changes in funding.
F) (Agency [belief]) Clinical dumping is apparent.
G) (Relational) Unintended nurses assume OAC role with potential adverse consequences on the GPs' workload.
H) (Agency [belief]) OAC practice could affect GP services capacity negatively.
I) (Agency [belief]) Providing access for patient to GP services is a priority.

Several mechanisms, identified within internalization, acted to both restrict and enable the OAC change, which further comprised the coherence component of the NPT. In GAPS-2, mechanisms with positive outcomes prevailed in developing the next phase of change, which is described next, as cognitive participation.

5.4.2 Cognitive Participation.

The next construct of the NPT involved the interpersonal work that the clinicians did, to create and maintain the new OAC practices. In this construct, a further four sub-components were analysed including initiation, enrolment, legitimation and activation. Each of these components will be discussed next.

In this section, both initiation and enrolment factors will be discussed together, as they were presented as being closely related. Firstly, May, *et al*. (2015) in describing initiation, explained that:

> "…*When a set of practices is new or modified, a core problem is whether or not key participants are working to drive them forward*."

Whilst, May *et al*. (2015) also explains that:

> "…*Participants may need to organize or reorganize themselves and others in order to collectively contribute to the work involved in new practices. This is complex work that may involve rethinking individual and group relationships between people and things*." Which they describe enrolment.

The initiation and enrolment aspects of the NPT were located within several contextual factors (Figure 37), and included, four main elements. These included, defining the OAC role, peer support versus peer-pressure and learning and developing OAC skills.

Firstly, the HCA role is developed, who secondly, then agrees to undertake OAC care.

Secondly, the GPs are then assumed to have clinical responsibility for warfarin decisions. Thirdly, all staff members are required to work across all areas of the QOF collecting data

whenever possible during their routine consultations. The nurses remained resistant to OAC change, and the GPs remained expectant of them eventually engaging.

Figure 37. Initiation & Enrolment - Contextual factors affecting OAC care.

Roles:

A) Nurses as assumed to undertake OAC care.
B) GPs are assumed to have clinical responsibility for warfarin-decisions.
C) The GP's role in the near-patient testing system is to oversee and maintain accountability for warfarin dose changes.
D) The HCA role is developed.
E) All staff work across all areas of the QOF.
F) The NC assumes a supportive OAC role for the HCA.

Practice:

G) Various clinical areas have specific QOF requirements.
H) All roles are linked to clinical leads around QOF components.
I) Each staff member has a specific clinical interest relating to QOF.
J) The HCA manages the initial INR-testing of warfarin-patients.
K) CDSS is used for dosing warfarin patients.
L) The HCA develops reflective practice to learn new role.

Having failed in their initial attempts to convince the practice-nurses to start managing OAC in-house, the previously discussed mechanisms had now resulted in a new developmental role for the HCA. The HCA had reluctantly assumed leading the routine work of the INR-testing. The NC would provide supervisory support for the HCA and this became the focal point for beginning the new service, thus, forming two further contextual factors. Firstly, the HCA would manage the initial testing of warfarin patients. Secondly, the NC would now assume an OAC supporting role for the HCA, as N3 explained:

> N3 (100-103) "…*no not gonna take the lead on it, cos it was* [NC] *[laughs] but I think initially with* [NC] *the both of us were going to get it started and work together*."

The emergence of leadership roles, which once again, developed at different stages and levels of OAC practice implementation, a belief in the value of team working and thirdly, an informal peer support system, were all mechanistic in enabling the nurses to help train each other in OAC care. Enablement occurred via raising awareness about OAC use and support that promoted, informed, and helped to sustain the early change in action. Finally, all three

mechanisms led to positive outcomes for OAC change, which was demonstrated in the following examples.

Firstly, peer support, although appearing to be positive by nature, was also threatening OAC change, by the ongoing resistance from the other nurses, as N3 further explained:

> N3 (58-61) "…*they* [the other PNs] *just told me to be careful at what I was getting involved with and to make sure that I always had someone to go to and not to take all the responsibility*."

By reflecting their own anxieties concerning the OAC change, the practice-nurses created new agency mechanisms, which endangered N3's confidence in moving the OAC change forward. These included, beliefs about role-safety in relation to the OAC care provision, underpinned by relational factors, represented by the ongoing conflict between the practice-nurses and GPs, concerning the assumptions of them acting in an OAC capacity. Both mechanisms resulted in negativity and a heightening of the underlying nurse's anxieties.

The input from the GPs, had also failed to meet the prior agreements with the nurses. Such that, they had promised to be available for referrals, by being logged onto the CDSS for warfarin dose changes and weren't. Further, the process of undertaking an INR-test was not as simplistic as the GPs had portrayed. These factors, further affected the nurses' attitudes towards the GPs and the OAC care process, which was exemplified by N2 and explained by N3:

> N2 (60-62) "…*I do feel that initially it painted a picture from the GPs that yes they were all going to be you know holding a responsible position to this, but it never happened*."

> N3 (177-194) "…*as we started [sigh], I started doing some case studies…of atrial fibrillation and warfarin and I went away …and just tried to get a lot of information about…why do people need to take it and then I looked at atrial fibrillation…why it*

was used for atrial fibrillation, and I got a lot of information [that I needed to discuss when dosing]*… I got more support from* [NC] *than really any of the GPs. I would go and see a couple of them* [The GPs] *from time to time, but they were always very much, oh I'll just stick to what the INR Star says, you know the dosing system, and sometimes it wasn't good enough*."

This example demonstrated, a lack of a previously agreed GP role in the near-patient testing system, which was supposed to mitigate against an ongoing culture mechanism relating to nursing fears about taking responsibility for warfarin-dosing. A lack of GP support was initially mechanistic in producing negative OAC outcomes, by reinforcing a general nursing resistance to OAC practice here.

However, as N3 explained, new mechanisms emerged that enabled the change to continue. For example, nurse-perceptions concerning how the GPs understood and cared about nursing training needs, was mechanistic in producing attitudes, whereby the nurses felt that the GPs didn't understand or care about the knowledge they needed to practice.

Thus, they stopped going to them for advice. A further culture mechanism, concerned the support-needs of nurses, required to develop their own OAC practices.

This mechanism resulted in the nurses seeking to solve problems between themselves, using their own experiences of undertaking the OAC process in practice.

For the HCA, learning the actions of the OAC role had now become a new practice factor. As such, the HCA developed a reflective clinical learning approach to practice. This itself created two further agency mechanisms. Firstly, the HCA took ownership for her own learning, gaining knowledge necessary for her to undertake the OAC role. Secondly, the HCA's initial fears of warfarin are superseded by a willingness to learn for the role. Both mechanisms, resulted in positive OAC outcomes that required enthusiasm for the role, but also increased awareness, which was then used to inform and sustain the OAC change.

To summarise, several mechanisms are summarised (Figure 38) that explained why most of the nurses were still reluctant to engage in OAC change.

Figure 38. Initiation & Enrolment - Mechanisms affecting OAC care.

A) (Structures [practice]) Various leadership roles emerged at different stages and levels of implementation.
B) (Culture [agency]) The notion of team working is valued.
C) (Relational) Peer support – the nurses help to train each.
D) (Agency [belief]) There are safety concerns relating to the actor's role in OAC.
E) (Relational) Staff are in conflict and the nurses deliberately refused to change practice.
F) (Agency [belief]) Nurses are initially fearful about using the CDDS and taking responsibility for the decisions.
G) (Relational) The perceptions of how the GPs understood and cared about nursing training needs.
H) (Culture [structure]) Nurses needed support to develop their OAC practice.
I) (Agency [belief]) The HCA takes ownership of the OAC role.
J) (Agency [belief]) Initial fears of warfarin are superseded by a willingness to learn role.

This was despite, promises and assurances from the GPs about how easy the OAC process would be for them. These concerns are confirmed by the HCA, when the reality of daily practice, is found to be more complex and required more knowledgeable support, that was not provided by the GPs. As a result, the HCA begins to develop knowledge and alternative support systems, to make the OAC practice workable, which is explored further, in the NPT component of legitimation.

May, *et al*. (2015) explain "*Legitimation*" by stating:

> "…*An important component of relational work around participation is the work of ensuring that other participants believe it is right for them to be involved, and that they can make a valid contribution to it*."

In legitimation, four new factors emerged that were built on new contextual factors (Figure 39). These included conflict between roles; awareness of the OAC processes; trusting GP OAC advice and GP-concerns about the quality of OAC care.

Figure 39. Legitimation - Contextual factors affecting OAC care.

Role:

A) The HCA and the NC are the only nurses engaged in OAC care.

Practice:

B) Nurses have experience of other practice and role changes.

Firstly, as most of the nurses were not initially involved in the practical initiation of the OAC service, a contextual factor concerning roles created both a further two mechanisms that would affect OAC care. Concerns about being open to change, caused divisions within colleagues, in opposition to change. Secondly, for the HCA, peer-pressure and associated feelings of obligation towards the GP-employer, affected her willingness to change practice. However, she also felt pressure from the nurses who were opposed to change, as N3 explained that:

> N3 (278-284) "…*yeah I kind of felt like I was in the middle a bit I guess of the GPs and the nurses, …they* [the GPs] *wanted me to do something and I guess I said…I agreed to it not knowing much about it and the nurses were sitting there trying to make sure I was protected by saying make sure you know, don't just jump into anything*."

This peer-to-peer advice was also set in the background context of previous change experiences of the other nurses' roles, which had reluctantly been undertaken, as explained by N2:

> N2 (702-707) *"…well we had no say in it though did we seriously? ... It was like when they did the baby clinics, we had no say whatsoever, we were told we were going on it, we were going on a study day end of story, you are now doing the baby clinic."*

The effect of the above mechanism for N3 was one of potential conflict. Making the OAC processes work required knowledge, skills, practice and practical support by the GPs, who had initially promised it.

In trying to make the OAC systems work, N3's effort was further complicated by her own anxieties of developing this practice, which the other nurses were keen to protect:

> N3 (146-158) "…*I felt like I was under a lot of pressure really, because…it wasn't something like learning a new task because there was medication involved, …I don't know anything about that* [AF], *I didn't know the importance of warfarin and how it interacted with anything … and you know potential side effects from it, …if it's not used correctly it's not just like a normal tablet, …there could be quite severe consequences*."

Here, N4's fear about the OAC role, based upon a lack of knowledge and experience, conflicted with her feelings of obligations to change, under pressure from the GP-employer. These were mechanistic, resulting in outcomes, that required solutions to overcome negativity towards OAC change, such as, the requirement to have adequate clinical advice. As the other practice-nurses began to experience the OAC systems, they too, building upon their own prior expressed concerns, reported feeling anxious about the GP-portrayed over simplicity of the CDSS, as N1 indicated:

> N1 (86-91) "…*well we were told…anyone can prick a finger, basically it was sort of sold to us in that way which yeah anybody can do that, but…you need to be looking at the implications of doing a test and what you're gonna be doing with results, personally…that wasn't good enough for me to just oh yeah you, you know you prick the finger without any further thought into what was going on*."

Three key relational mechanisms emerged here, relating to how nurses viewed and reacted to GP support.

Firstly, the nurses negatively perceived the GPs' abilities to provide education and support about clinical questions, when undertaking CDSS. Secondly, the nurses also perceived that the GPs failed to understand or care about the nursing training needs. Thirdly, the nurses

didn't trust the GPs' explanations when required, about individual patients' INR/warfarin-dosing queries. Each of these factors were also mechanistic in generating negative OAC change outcomes, re-enforcing the nurse's belief, that it shouldn't involve them.
For the GPs, in legitimation, quality of care was the important factor, which also was an underlying mechanism for individual practice, as GP4 explained:

> GP4 (97-109) "…*so I had my appraisal yesterday and for my next year one of my PDP things is to* [ensure quality of OAC care] …*but it's not as robust as some of our other systems and we're trying to step their quality up. I don't think everybody else is always as feeling as proactive about that, you want to make sure it's right for people though don't you*."

Despite the context and the concerns of the nurses above, there were also, GP-specific mechanisms identified, that affected the outcomes for the POCT systems here.
These included beliefs about the importance of assessing and raising the standards of quality of care for patients in the practice with a now specific, focus on OAC care provisions. These mechanisms positively influenced the GP's awareness and were used to inform the need for continued OAC change.

To summarise, the HCA obligation to her GP-employer, was high enough to continue the drive to engage in change, however, the more experienced practice-nurses were more guided by their fears about their role in OAC care, and the possible legal consequence of making clinical errors in practice. Similarly, the lead GP, was concerned with external pressures relating to managing the quality of care in the practice, particularly now in relation to OAC care. Each of these mechanisms (Figure 40) helped legitimatize each other's clinical participation in OAC care, which led to activation of the OAC change.

May *et al*. (2015) explain "*Activation*" by stating:

> "…*Once it is underway, participants need to collectively define the actions and procedures needed to sustain a practice and to stay involved*."

Figure 40. Legitimation - Mechanisms affecting OAC care.

A) (Agency [belief]) Being open to change caused division with colleagues in opposition to change.
B) (Relational) Peer-pressure - Staff felt obliged to change towards the GP employer.
C) (Relational) Peer-pressure - Staff felt obliged not to change towards nurse colleagues.
D) (Culture [agency]) The nurse had no experience of managing AF or OAC created fear.
E) (Relational) The HCA felt obliged to change towards the GP employer.
F) (Relational) There is mistrust in the GP abilities around OAC care.
G) (Relational) There are poor perceptions about how the GPs understood and cared about nursing training needs.
H) (Relational) The nurses didn't trust the GPs explanations of the OAC process.
I) (Culture [agency]) The GP's professional development appraisal prompted him to re-examine the prospect on new near patient testing systems.
J) (Agency [belief]) Concerns about quality of OAC care encouraged practice to change.
K) (Agency [belief]) There is a belief of improved quality of patient care available for patients.

In activation, four contextual factors were identified (Figure 41) with two further key enabling factors demonstrating how the clinicians organised and sustained the OAC practices. These included nursing collaborations involving training and problem solving. This included the development of an OAC protocol and standard operating procedure (SOP) and clinical practice problems.

Figure 41. Activation - Contextual factors affecting OAC care.

Roles:
A) The HCA leads routine POCT.
B) The other practice-nurses all undertake some POCT when required.

Practice:
C) POCT is based upon an OAC policy and a SOP.
D) The HCA instructs the practice about POCT.

Firstly, the importance of nurse collaboration and partnership was explained by N3:

> *N3 (44-53b) "…I think communication was a big thing with* [NC], *not so much the GPs, because we were kind of left just to get on with it, I think we created things like standard operation procedures, we created an information booklet for the patients, …we spoke quite regularly about how we were running things, what was working well, what wasn't,…if I needed any extra help or training or things like that."*

Here, the context included the lead-role of the HCA on the routine POCT, with support from the other practice-nurses when required. However, in practice, the actual POCT was also based upon a policy supported by a SOP.

In activation, several additional, enabling mechanisms developed. These included, both formal and informal practice reflections, which coexisted with how the nurses needed support to enact and develop their OAC practice.

Outcomes responses to the above mechanisms, created a further relational mechanism, whereby the nurses developed OAC support systems without any input from the GPs. Secondly, Undertaking the OAC role, was itself, considered to be a mechanism that led to awareness to develop further knowledge.

Each of these mechanisms identified in these examples of activation, resulted in positive OAC outcomes. The nurses are now engaging with the OAC systems and knew what solutions were required, solving problems between themselves and applying their own experiences of the process of OAC in practice. Thus, growing awareness was used to inform and sustain the OAC change.

Training of the key staff had also been undertaken, which facilitated their engagement in the OAC systems. All staff were offered the same training opportunity at the beginning, but the three nurses that had initially declined to participate in the OAC change, had also declined to train. This later became a factor of contention for them, as N2 depicted:

> N2 (379-391) "…*what training?, well we start, …we sat in with xxx …initially…she talked us through it as we were actually putting the information on the computer, she demonstrated and we watched her do that while she was taking bloods, …talked us through how to get the correct measurement and what to do if things failed, which obviously they have done, so it was a fairly like nice step-by-step approach*."

Instead, the HCA had become the focal point for instructing the other practice-nurses about how to undertake POCT. This was based upon her developing experience with the OAC systems. New mechanisms arose from this, concerning existing negative perceptions about formalised training, now in relation to OAC roles. The outcome was to cause the nurses to feel unprepared for the role, increasing their stress and demotivation towards it.

However, a positively influencing relational mechanism also arose, whereby nursing peer support, focusing on the OAC role, which (*leading by example)*, acted to raise awareness, inform and maintain OAC change, a view supported by GP2:

> GP2 (220-227) "…*resistance as you may recall, came from the practice-nurses,* [NC] *were quite involved and then* [HCA] *and I think well primarily* [HCA] *did it, and I think the practice-nurses then felt they could do it*."

Therefore, the work undertaken by the HCA and NC to develop the SOP, OAC protocol, and informal training, encouraged the practice-nurses to engage in OAC roles. Structuring the procedures and explaining the processes and roles of the other team members, was therefore achieved by several mechanisms (Figure 42). These enabled the OAC change to activate within the wider general-practice, in what is described next, as collective action.

Figure 42. Activation - Mechanisms affecting OAC care.

A) (Culture [agency]) Reflection on practice with both formal and informal discussions, lead to OAC practice improvements.
B) (Culture [structure]) Nurses needed support to enact and develop their OAC practice.
C) (Relational) The nurses developed OAC support systems without any input from the GPs.
D) (Culture [structure]) Undertaking OAC role leads to awareness to develop further knowledge.
E) (Culture [agency]) There is a perception of inadequate training for nurses.
F) (Relational) Peer support – the nurses help to train each other about OAC practice.

5.4.3 Collective action.

Collective action is the next NPT construct, which covers the pragmatic work the clinicians did to make the OAC changes work in daily practice. A series of sub themes also exist in the collective action construct of the NPT and its individual component sections (Interactional Workability, Relational integration, Skill set Workability and Contextual Integration).

According to May *et al*. (2015):

"*…Relational integration refers to the knowledge work that people do to build accountability and maintain confidence in a set of practices and in each other as they use them.*"

Relational integration, situated within several contextual factors (Figure 43), was also comprised of different themes. These included clinical support for nurses; GP availability; trusting GP advice about CDSS; nurse teamwork; nurse leadership; GP safety concerns and GP AF management including the use of risk-scoring.

Figure 43. Relational integration - Contextual factors affecting OAC care.

Role:

A) The nurses now have a role in warfarin management via the LES.
B) The GP's role in the near-patient testing system is to oversee and maintain accountability for warfarin dose changes.
C) The nurses undertake INR-testing but are wary of warfarin dosing.
D) The NC assumes an OAC leadership role.
E) GPs have a role in identifying and managing new cases of AF.

Practice:

A) The CDSS program is adopted for warfarin management.
B) GPs treat AF according to best practice.
C) CHADS2 risk-scores were now being discussed in relation to AF stroke-risk.
D) HASBLED-scoring is used to estimate bleeding-risk.

Processes:

A) The nurse performs the POCT, takes the history. The GP assumes Warfarin-dosing responsibility.
B) GPs use OAC guidelines (NICE) to decide on patient's best treatment.

Firstly, the quality of clinical support, available to the nurses whilst undertaking OAC care, emerged as a key problem. This support centred on how the GPs and nurses defined their roles in action, and how the nurses defined trustworthy clinical support in relation to using the POCT and DCSS.

Clinical testing and management of warfarin wasn't always simplistic. For example, N4 described a patient episode presenting with complications:

N4 (162-173) "...*a warning came up on the screen saying that you have to confirm and consider other things, I was thinking well I'm a bit out of my depth here cos all*

the heart failure and everything else that's going on, is it for me to say that? he's [the GP] *okay with that?, I didn't think I was qualified to,…so then when I do ask?, I did ask one of the other GPs while I was waiting and he just said umph I don't know anything about the system there you'll have to bring him back in to see me tomorrow.*"

Contextually, this response was composed of five components including role, practice and process components (Figure 43) that have been previously discussed. However, in relational integration, the key factor related to the process factors that relied upon the GP assuming warfarin-dosing responsibility.

The GPs had previously agreed to be on-line within the facility of the CDSS, for referral help for the nurses, which had not occurred in practice. This presented a pragmatic challenge for the nurses in action of their OAC practices. Thus, three mechanisms were also identified here that potentially affected OAC use and pertained to the expertise of the nurse and the support of the GP.

The first two mechanisms, highlighted previously, related to the nurse's own anxieties about knowledge and capabilities, to manage this situation. The third mechanism related to the GP role in the OAC process. Namely, that the GPs, had failed to engage in electronic dosing systems, as previously agreed. Initially, to satisfy the nurse's fears about taking warfarin-dosing responsibility, it was proposed that the GPs would assume the responsibility. Hence, if the nurses came to situations that required authorisation for warfarin dose changes, based on abnormal INR results, then the GP would be available by utilizing the electronic referral facility on the CDSS.

Furthermore, initially, the nurses questioned dosing changes with the GPs as a learning method, but the GPs always encouraged trust in the CDSS decisions. However, this advice was deemed unsatisfactory by the nurses for several reasons:

N3 (43-55b) "...[the NC] *sort of allayed our fears in a little bit, I felt that if we came to* [the NC], [he] *knew what* [he] *were talking about, whereas* [*short laugh*] *if we went*

to the GPs they didn't, they weren't interested in the patient they were interested in what it said on the screen, so me saying you know he doesn't look very well today or that, they would just say well what does it say on the screen, that's fine, where he should be more interested in what was going on and...It's hugely important."

N3 above, explained how direct patient clinical insight created uncertainty in the accuracy of the electronic dosing decision, and the unsatisfactory advice offered by the GP. This further created some mechanisms with potential negative OAC outcomes. The nurses relied upon the GPs to fulfil their promises about warfarin-dosing responsibility, and further, requested supervision about dosing decisions that didn't happen. Consequently, a relational mechanism emerged, whereby the nurses lost trust in the GP-advice about warfarin-dosing. The negative responses to these mechanisms may have resulted in outcomes, such that, the nurses continued to be unprepared for the OAC roles, resulting in stress and demotivation, as suggested by N3:

N3 (392-402c) "…I thought the GPs could have been a bit more supportive, but you don't always feel that they've got the time to put into it, or maybe …the same sort of enthusiasm…they know what they know, and they'll just give you a quick answer,…you can turn around and say well no, I know this and this is why."

However, not to be deterred, another positive outcome emerged, which involved, how the nurses themselves, developed the knowledge, skills and leadership to have the confidence to evolve OAC practice, as depicted by N3 below:

N3 (209-218) "…*I stopped going to them* [the GPs] *as often,…they weren't dealing with these patients all the time like what we were, and it made me question, not their knowledge…I felt like I had to take more responsibility rather than just saying oh well Doctor such and such told me to do that when I didn't agree with it, or if it didn't make sense to me. It just made me question their* [GPs] *confidence about it*."

The context factors now produced a new agency-mechanism, whereby, the HCA became enabled to develop taking OAC dosing responsibility, independent of the overall GP-accountability. This occurred via experiential learning, distrust in the dosing advice from GPs, and peer support from the other nurses, who were also applying the CDSS in their own OAC practices. For example, the nurses sought to solve problems between themselves, using their own experiences of the process of OAC management in practice, as explained by N2:

> N2 (162-170) "…*seeing your patients, discussing them…and knowing that there's somebody else that you can go to…I do feel that from the point of view of working colleagues not GPs that we,* [nurses] …*know you can ask and bounce things back off, off each other, so I think that's nice that we've got that*."

This group awareness was further evidence, of how the nurses promoted and sustained the OAC change here.

A further positive outcome that occurred because of the GP-approach to managing the CDDS decisions was the emergence of clinical leadership amongst the nursing group themselves. For example, the NC developed a special interest in OAC and was also responsible for mentoring the HCA in the practice:

> N1 (218-221) "…*well we tend go more to* [NC] *than anybody else, because I felt more confident in what, in the response that* [NC] *give us, and that's still the case*."

Furthermore, working as a nursing team, produced confidence in each other's ability to practice OAC here, as explained by N2:

> N2 (67-75) "…*obviously five of us doing this and as yet we haven't had any major, I haven't had any major incidents other than one that* [the NC] *sorted out,* [the NC] *were on duty at the time and the patient went off to hospital, the rest of I, I would find as sort of fairly straightforward for the patients here*."

The evolving contextual factors, suggested by N1 and N2, both highlighted the importance of a nursing leadership role. This led to nursing trust and confidence in the NC's capability to provide OAC advice. However, the NC's OAC role also became a trusted source of advice used by the GPs. Both factors were mechanistic in leading to positive OAC outcomes, whereby, the NC became the focus for OAC advice, enabling OAC practice continuance, by promoting and sustaining the OAC change.

The GP-perspective, in relation to the relational integration component, was dissimilar to that of the nurses. There was a scarcity of evidence that related to the concerns around their supposed role in the POCT and CDSS systems as previously agreed, and as expressed above by the nurses:

> GP4 (344-353) "…*I think when anyone does anything new, it's just the initial change anxiety, from my side…if something goes wrong you know having the right protocol in place that, that you know if somebody's INR's through the roof you're gonna do the right things and those sort of usual things that actually once you've done it a while they're okay, and I think they were the same with the nursing staff really I would assume*."

Instead, there was an acceptance expressed from GP4, about the existence and concerns of anxieties, relating to changes in practice, from both clinical groups. For the GP, existing contextual factors created assumptions about change anxiety.

However, the GPs did have wider responsibilities beyond the LES, which perhaps, wasn't appreciated by the nurses, and evidence for this was present within the relational integration component. For example, as GP5 declared, AF diagnosis and stroke-risk associated with AF, had now become a clinical priority:

> GP5 (179-191) "…*I think the things that have driven change is* [NC] *enthusiasm...* [also]…*all of us as GPs have been on courses to appreciate the impact of AF on patients…there is a high-risk to patients, plus of course that increasingly there could*

be the risk of litigation, so I think you know we're all aware that we are trying to manage patients according to best practice and recognise guidance."

In this response, the GP highlights the contextual factors of emerging roles, practices and processes relating to relational integration (Figure 44). Here, also changing attitudes and priority given to AF, stroke prevention and GP beliefs about the fear of litigation, become important GP-mechanisms that produced positive outcomes, by increasing GP-awareness, used to inform and drive OAC change.

Figure 44. Relational integration - Mechanisms affecting OAC care.

A) (Agency [belief]) There was a fear of what warfarin management entailed.
B) (Agency [belief]) The nurses had no knowledge required to undertake the role leading to heightened anxiety.
C) (Culture [structure]) The GPs fail to engage in electronic dosing systems.
D) (Culture [structure]) There is a perception of lack of GP clinical supervision.
E) (Relational) The nurses don't trust the advice about warfarin-dosing from the GPs.
F) (Agency [belief]) The HCA felt ready and able to develop OAC dosing responsibility.
G) (Agency [belief]) There is confidence in the NC to provide OAC advice.
H) (Relational) The NC having established OAC lead role becomes a trusted source of advice.
I) (Cultural [structure]) The importance of AF and stroke prevention has raised GP awareness and attitudes of priority towards them.
J) (Agency [belief]) There is a background fear of litigation.
K) (Agency [belief]) OAC guidelines are valued for use in practice.
L) (Agency [belief]) Education and awareness around OAC is deemed important.
M) (Relational) Leadership is valued.
N) (Cultural [practice]) QOF-AF and the LES were introduced to practice.
O) (Culture [structure]) AF and stroke prevention is the focus of QOF changes.
P) (Agency [belief]) AF and reducing stroke-risk is clinically important in routine work.
Q) (Agency [belief]) Stroke and bleeding-risk scoring is useful for GPs.
R) (Agency [belief]) NOAC drugs are of value in practice.

The GPs were now also concerned, with using OAC treatment, now being considered in accordance with both stroke and bleeding-risk, as GP4 explained:

GP4 (375-383) "…*I think…that's really changed* [awareness of stroke-prevention] *in the last year or two I think…the CHADS-2 the CHADS stuff and the HASBELD stuff and these new agents have come through…people are starting to grasp that it's more about risk and less about …. I'd better not give them anything*."

This GP demonstrated the expanded contextual factors of care, compared to earlier stages in the NPT. Particularly, in relation to how practice now included the expectation to implement stroke and bleeding-risk scoring and act on those results.

This evolving context had also resulted in new causative mechanisms, relating to AF, the introduction of assessment process and the GP beliefs about their importance to their practices (Figure 44). Each of these mechanisms resulted in positive OAC outcomes, by raising GP-OAC awareness, shaping positive attitudes and prioritising the importance of OAC in the practice.

To summarise, both the nurses and GPs, defined their actions around relational integration here, according to the different roles that they undertook. As such, different mechanisms emerged, to support both their concerns and needs. These then, led to action, which is described next as, skill set workability.

The next component of collective action involved "*skill set workability*", which May, *et al*. (2015) outlines as:

> "*…skill set workability refers to the allocation work that underpins the division of labour that is built up around a set of practices as they are operationalized in the real world."*

Skill set workability was contextualised by three main factors (Figure 45) and included themes relating to both nurse and GP-awareness of each other's roles.

Figure 45. Skillset workability - Contextual factors affecting OAC practice.

Roles:

A) The NC has a clinical leadership role in the OAC system.
B) The GP has no direct role now in the OAC system.

Process:

C) The nurses had no role in patient recruitment to the LES.

Firstly, the GPs and nurses, both lacked awareness about each other's OAC roles, which resulted in specific notions about their wider roles in AF and OAC practices. For example,

when N3 was questioned about other AF patients who were not managed via the LES, but for whom the GP held responsibility for, the nurse outlined:

> N3 (160-168c) "*…I've not really given much thought about is that… in all honesty I don't really give them* [AF patients not managed through the LES] *a second thought because they're not on our caseload of selected patients… instead of seeing the bigger picture I'm perhaps just only focussing on who has been put on my list*."

As the nurses had no role in patient recruitment to the LES, a concerning belief about role-task focus, became apparent, which became mechanistic for limiting the nurse's role beyond the scope of the POCT role. The resulting OAC outcomes were that the nurse was both unaware of the needs of the wider known AF-caseload and other clinician's responsibilities towards them.

To clarify if awareness was hindered by the boundaries of roles, N2 was also questioned about the AF-population not related to the LES:

> N2 (204-214) "…*I suppose we should take a more active role in that* [looking at AF patients not on the LES], *but… I think with everything that we do in our role we just haven't got the time*…"

In this response, N2 elucidated the underlying contextual practice pressures. However, a negative outcome also ensured whereby, the non-LES patients' needs remained unknown to the Nurse. These were typified by N2's beliefs about the nurses' input into the wider AF/stroke-risk surveillance and her lack of engagement in AF/OAC beyond her role in the LES, which were restricted by her own wider nursing duties. Both, nursing beliefs and actions within roles here were mechanistic, resulting in non-action for AF screening. Therefore, there emerged the potential for missing unmet AF patient need by a failure to engage in opportunistic screening. This is important because the unidentified AF patients, who were at risk of stroke, should also be recognised as part of an OAC underuse population. Therefore, any actions or non-actions that didn't promote AF case-finding further reinforced a perceived underuse of OAC within the practice.

The GP-perspective of the nurse LES role was grounded in concerns about safety and cost-effectiveness, which were again, misinformed by a lack of awareness of the nature of the nurse role in the OAC LES. Firstly, GP4 explained that although conscious about safety fears, these fears were measured against reassurances about his previous experience with nurses, in managing other conditions of risk. This was not relative to actual experience of the OAC LES itself:

> GP4 (65-74) "…*I suppose the quality controls side worries me,…you don't know if other GPs are looking at it, are they as willing to double check and make sure things are alright?...like the methotrexate, I'm happy that it's running as a quality assured thing because the nurses are doing it and they're really good at that side of stuff*."

The nurses had now developed and administered the protocol and procedures associated with the LES, which created a limited GP role in the LES once it had become established. This itself became mechanistic by increasing the GP concerns about safety of practice. However, GP beliefs about trusting the nurses' previous abilities in organising and managing other near-patient systems, were also mechanistic in increasing the GP's confidence about safety concerns.

However, having trust in the nurses' ability wasn't always enough, to satisfy a positive outcome for OAC change. For example, a further GP, also demonstrated a lack of awareness about the nursing OAC roles, by suggesting a perceived inefficiency in nursing time, and the effects on his own caseload, as GP4 quantified:

> GP4 (284-310) "…*I think the* [NC] *role has changed in that time…when* [NC] *initially came to the practice* [the NC's] *main role had been perceived to be looking after acute and minor illnesses…*[the NC] *see a lot less of those minor illnesses* [patients] *which then backflows on to the GPs, …so yes the negative impact is that there's less appointment time …the difficulty with that is because* [the NC is] *so highly trained, that for* [the NC] *just to be sat doing a warfarin level isn't always the most cost-effective way is it?, it's a bit like me …just doing a blood pressure …I shouldn't be just*

bringing somebody in to do a blood pressure…each should be devolving those around,…within the next twelve months we'll probably have a change in the way the workforce is and adapt it so that [the NC] *have more of an overseeing role*."

As the GP now had no routine part to play in OAC systems, the GP became unaware of the extent to other nurse's roles in it. Thus, the GP's beliefs and lack of awareness about individual nurse's roles within the LES became a mechanism for assuming the NC's role within the OAC practice to be inefficient. Further, the GP believed that the NC's role in OAC was detrimental to his own workload.

Figure 46. Skillset workability - Mechanisms affecting OAC care.

A) (Culture) [agency]) The nurse focusses on the specific tasks and responsibilities of her role.
B) (Cultural [agency]) The wider AF/stroke-risk surveillance is not viewed as part of the immediate nursing role.
C) (Structural [practice]) The GP has a limited role in the LES once established).
D) (Cultural [agency]) The GP relies on the nurses to design, organise and manage the OAC systems associated with the LES.
E) (Agency [belief]) The GP trusts the nurse's previous abilities in organising and managing other near-patient systems.
F) (Relational) The GP trusts the work that the nurses do enacting OAC management.
G) (Agency [belief]) The GP lacks awareness of individual nurse roles within the LES.
H) (Culture [agency]) The GP believes that the NC's role in OAC affects his workload.

To summarise, both clinician groups experienced their roles in OAC care differently, with further contrasting ideas about each other's roles, which were reflected by several specific mechanisms (Figure 46). A lack of awareness about role activity resulted in mechanisms that produced negative outcomes, potentially threatening the persistence of the OAC systems. This is descried next, as contextual integration.

The next component of collective action involved "*contextual integration*" which May *et al*. (2015) outlines as:

"*…contextual integration refers to the resource work - managing a set of practices through the allocation of different kinds of resources and the execution of protocols, policies and procedures*."

Contextual integration involved several new contextual factors (Figure 47) and themes that included, new OAC procedures, QOF impact on nurse consultations, adapting POCT consultations, minimizing MDT burden enacting OAC, discussing stroke-risk, GP OAC decisions, managing historical stroke-risk and in-house expertise.

Figure 47. Contextual integration - Contextual factors affecting OAC use.

Roles:

A) All nurses are now engaged in OAC LES.
B) All practice roles relate to data requirements based around the QOF.
C) The GP role includes AF case finding and decision-making about OAC.
D) GPs don't interpret ECGs.
E) The NC assumes a clinical leadership role in OAC.

Practice:

F) OAC LES was underpinned by an OAC policy and SOP.
G) Various clinical areas have specific QOF requirements.
H) All staff work across all areas of the QOF.
I) Patients have specific needs relating to their INR-testing.
J) GPs refer AF patients to cardiology for AF management decision-making.
K) The changing QOF influenced core duties.

Processes:

L) The HCA is working the OAC patient encounter autonomously.
M) The OAC LES is operational.

Firstly, an OAC policy and protocol, were part of the fundamental pillars for the LES, and enabled the nurses in this practice, as N3 clarified:

> N3 (300-310c) "…*we do the annual reviews, we have a standard operating procedure and protocol that we follow, we score the patient to see what sort of risks…they are, …every time we see them we're constantly reviewing them and asking about any previous you know bleeding or bruising*."

The protocol was under constant review and formed part of the contextual factors for practice. This protocol, which was developed experientially, was used as a reference becoming mechanistic in enabling users with confidence, to enact the OAC change.

However, the developing protocol was also flawed, as it was based upon a previous agreement with the GPs, which included their supposed on-line availability, which was never enacted. For one nurse, this appeared to limit the value of the protocol:

> N4 (151-154) "...*we discussed that* [online GP support] *when…formulating the protocol, but that it doesn't work does it, cos what we're supposed to do doesn't happen, you know the support we're supposed to get from the doctor!"*

However, mechanisms were identified here which potentially nullified the positive outcome for the protocol described above. Firstly, the nurses required support to enact their OAC practice, but there were nursing-beliefs in a lack of GP support with OAC management, which contradicted the OAC protocol. This related directly to how the GPs had failed to engage in the CDSS, as previously agreed. Thus, there were concerns raised by the nurses, as to the value of the OAC protocol, in actual practice. Each of these factors were also mechanistic in producing potentially negative outcomes for OAC practice.

The effect of changing requirements of the QOF was also an important determinant of contextual factors such as evolving roles and processes, as N4 emphasised:

> N4 (277-283b) "...*there's more things to be done in a session now…everything now has got popups with loads of questionnaires that you've got to ask and go through, and I think that takes away quality time with your patients*."

The nurses' agency concerning their beliefs that they were under pressure to do more in the allotted time, were also mechanistic in affecting the quality of OAC care provided. As a result, N4 developed negative attitudes towards the effect of OAC duties and that of further change.

However, disruption to normal nursing duties by enacting the POCT was also apparent and this required adaptions to the methods of nurse consulting:

> N2 (786-795) "…*sometimes it like depends on how bad they are they're breathless or whatever, you can't just say right give us your hand! some of them, God love them,*

when they come in, they're freezing and you've got to warm their hands up, …I mean there's one I could actually say I could do with thirty minutes with him because I can't get him out the room once he comes…just sort of to get the circulation going because you know obviously your first finger pricks not gonna work on them."

In this example, practice factors relating to individual patient needs, led to new consultation management challenges. As such, valuing patient-specific knowledge in assessing the need for flexible consultation styles in OAC care became mechanistic in producing outcomes, where the nurse was adaptive in her practice. This nurse developed her own style to undertake the action of OAC consultations, recognising the need for flexibility in planning, for specific and individual care arrangements.

This outcome also positively encouraged understanding of planning needs for future appointments and the possible effect on the rest of the caseload for that session. This new understating thus deflected the possible negative effects of specific and expected long delays in the POCT with some patients. Adapting nurse consultations also helped to reduce burdens on the wider MDT, as N3 outlined:

N3 (107-118c) "…*I think I try and manage my patients as best as I can even to the point where if they need a prescription I will go and organise it rather than them going out to reception. I don't really…involve reception much at all. I try not to make any sort of an impact on anyone else, I see my patients as more my responsibility and that includes booking appointments, if they need to see a doctor I'll make the appointments, I don't send them out to reception for anything*."

The key process factors, which reflected the HCA working autonomously during an OAC consultation, were mechanistic in both reducing the burden on the wider health care team, and the value placed by the HCA autonomy in her OAC role. The positive outcomes are that other staff are protected from the negative effects of disruptions described above, and that patients leave with all the correct information and without delay.

The GP-perspective, was located within the context of role factors, concerning finding AF and deciding on OAC. This included decision-making, when discussing risk with often asymptomatic patients, as depicted by GP5:

> GP5 (279-287) "…*most of them* [patients] *have no symptoms, it's like blood pressure. I mean people know that they have to have their blood pressure checked, but you have to emphasise why you need to have it checked and why you need to treat atrial fibrillation…and why they need to be on treatment, and what are the risks of that treatment, you know whether it's warfarin or something else."*

In this instance, the GP's attitude towards perceived bleeding and stroke-risk was also mechanistic in his approach to OAC practice. This resulted in positive OAC outcomes, by raising GP engagement in stroke prevention practice, which also sustained the OAC change. However, as GP5 clarifies, discussing risk of stroke with asymptomatic patients can be challenging, especially in the short time allotted to routine GP appointments:

> GP5 (271-277) "…*it's not difficult to talk about a risk…we discuss all sorts of risks, we are risk managers, but I think the, the big problem we've got is time…also you're talking to patients about something which doesn't bother them*."

Here, it emerged, that the GP's concerns produced a belief that there was not enough time to discuss risk with patients within a consultation. This was a potential mechanism, which if applied by the other GPs, may have led to negative outcomes, such as missed opportunities for offering stroke prevention information.

However, as was captured in GAPS-1, the GPs still chose to transfer the responsibility of OAC decisions to cardiologists, which confirmed the contextual role factor, that the GPs didn't interpret ECGs themselves, and a practice factor, relating to how the GPs prefer to refer AF patients to cardiology, for AF-management decision-making. Different reasons were cited regarding the GP roles with ECGs and OAC decisions, which included requests for expertise in interpreting ECGs when diagnosing AF (GP2), and the potential need for DCCV (GP4), as depicted below:

GP2 (48) "… [in detecting new AF] *my first approach would be to confirm it or exclude it with an ECG and I prefer to send them off to the cardiologist… because I feel there's subtleties, although an ECG…is quite easy to read the number of subtleties can be mis-read…maybe the others* [GPs] *feel more happier about reading them."*

GP4 (405-13) "…*but if they're stable AF's in a sense I'm often just referring so that they can go and have their echo and they can decide whether they think there's somebody for cardioversion and then for the warfarin initiation*."

The prevailing GP beliefs about externally held OAC expertise, continued to be mechanistic in the GP decision-making process. Therefore, there were potentially long delays for appointments for patients that would require initiation of anticoagulation, a finding supported in GAPS-1.

The above examples related to individual patient scenarios. However, in the context of practice and the influence of the OAC on core duties, a cultural mechanism arose. The changes to QOF and specifically the AF components, determined positive OAC outcomes. Namely, that the practice had to demonstrate stroke-risk assessment and reduction decisions, for the entire AF caseload for the first time. Consequently, within this context, one GP devised a plan based upon two mechanisms. Firstly, AF awareness via the QOF, altered priorities of care. Secondly a structure mechanism concerning using external resources, enabled the GP to increase the quality of care, as outlined by GP5:

GP5 (406-418) "…*there are patients that will require a cardiological assessment, and obviously we've identified a certain group of patients who we probably do need to have them reviewed, so we've actually agreed that a company to come in and audit those patients…in conjunction with the ABPI regulations for a cardiologist to come in and do a clinic in primary care to review those patients ….so that actually means that the patients will get an expert opinion and we will get a sort of management plan on what's suitable for them* [OAC]."

The outcome of enacting this mechanism was positive for the practice, as it aided the GPs in achieving a QOF requirement with minimal input from their own resources. Although, this method, also failed to increase the GPs' engagement in actual decision-making about OAC use. Instead, it reinforced the role of the expert, external to general-practice.

However, changes within the context of practice and roles now also involved an operational LES, with the NC assuming a lead role in OAC, which was itself, mechanistic of creating in-house expertise, as described by GP3:

> GP3 (471-479) "…*we've had a few chats* [about] *patients that I've had a query with, and I'd much rather come to speak to* [the NC] *cos* [the NC has] *got an interest in it rather than having to speak to the somebody at the end of a phone at the anticoag services, it's made me sort of more aware of what, what we can and what we can't do here."*

In the above example, the outcomes for the GP's role in OAC are positive, showing that they were now more prepared to explore options about OAC decisions themselves. This indicated, a progression towards GP OAC autonomy, moving away from the culturally accepted norm, of deferring to cardiologists.

To summarise, contextual integration involved several new mechanisms (Figure 48), which enabled positive outcomes for enacting and reinforcing OAC practices here. Overall, collective action also resulted in CMO-configurations, which enabled the development of several formal and informal systems. These systems evolved to mutually suit the needs of both the nurses and GPs, in their individual roles. However, there also appeared to be a division in cooperation across OAC care. The value placed on these new care changes, are discussed next, in what is described in the NPT model, as reflexive monitoring.

Figure 48. Contextual integration - Mechanisms affecting OAC care.

A) (Structure [processes]) Developing and enabling of the OAC protocol.
B) (Agency [belief]) The nurses believe that there is a lack of GP support in helping them manage OAC.
C) (Culture [structure]) The GPs fail to engage in electronic dosing systems as previously agreed.
D) (Culture [structure]) The nurses needed support to enact their OAC practice.
E) (Agency [belief]) There is no faith in the enabling effectiveness of the OAC protocol.
F) (Agency [belief]) The nurses feel under pressure to do more in the allotted time.
G) (Structure [practice]) OAC consultation quality is affected by general workloads.
H) (Culture [agency]) Consultation styles need to be flexible.
I) (Stricture) [practice]) Knowledge about specific patient needs is important.
J) (Culture [agency]) The nurse values autonomy and the responsibility of the OAC role.
K) (Structure [practice]) Changing GP attitudes towards perceived bleeding and stroke-risk affected practice.
L) (Agency [belief]) The GP believes that there is not enough time to discuss risk with often asymptomatic patients within a consultation.
M) (Culture [belief]) The GP does not consider himself to hold expertise.
N) (Cultural [practice]) QOF-AF components determine changes to OAC practice.
O) (Culture [structure]) The importance of AF and stroke prevention has raised GP awareness and priority towards them.
P) (Structure [processes]) The GPs uses any external resources that are available to them to increase the quality of care.
Q) (Structure [practice]) In-house expertise emerges.

5.4.4 Reflexive monitoring.

Reflexive monitoring is the final NPT construct, which referred to the evaluative work the clinicians did, to assess the OAC change work, in their daily practice. Like the previous NPT constructs, reflective monitoring has four subsections (Systematization, Communal appraisal, Individual appraisal, Reconfiguration) that were included in this analysis.

This section reported on two of the sub-categories of reflexive monitoring, systematization and communal appraisal. Undertaking analysis of these two factors was found to be problematic, as distinctive evidence wasn't available, to satisfy the NPT definitions. For example, systemization was explained by May *et al*. (2015), as the ways in which the clinicians here established:

> "*…how effective and useful it is for them and for others*."

This included the collating of different types of data both formal and informal. However, communal appraisal is also stipulated by May *et al*. (2015) as:

> "*…participants working together - sometimes in formal collaboratives, sometimes in informal groups to evaluate the worth of a set of practices. They may use many different means to do this drawing on a variety of experiential and systematized information*."

In GAPS-2, the above definitions of systematization and communal appraisal appeared to be closely related by the available evidence when it was summarised. For example, systemization and communal appraisal were both represented by adversity relating to OAC practice change concerning specific contextual factors (Figure 49) and summarised by several specific mechanisms (Figure 50).

Both, GPs and nurses, referred to adverse effects on their practice session times, relative to being involved in the OAC changes. However, this was reported differently, depending upon role type. For example, one nurse considered the OAC practice to be just another role-dimension, adding to their expanding caseloads, as exclaimed by N4:

> N4 (267-263b) "... [undertaking OAC care] *it just gives you less time to do things, I mean we've had to take on the immunisations as well round about the same time cos the health visitors don't do them anymore, it's just something else you've got to do your best at really…it is difficult*."

The importance of the N4's agency or belief, about how the OAC role had impeded core duties, may have negatively affected her attitude about continuing this OAC change.

Figure 49. Systemization & Communal appraisal – Contextual factors affecting OAC care.

Role:
A) GP role is to identify and managing new cases of AF.
B) The nurses entirely manage the POCT clinics Practice.
C) The GP discusses stroke-risk with patients.
D) The nurses are now considered expert in OAC care.
E) The GP has shared managerial responsibilities.
F) The GP employs staff to deliver services.
G) All nurses are engaged in the OAC LES.

Practices:
H) LES contracts are subject to alteration and termination.
I) NOAC drugs are beginning to be used by GPs.
J) The OAC LES is established.
K) All staff are palpating pulses in practice to screen for AF.
L) Pulse recording is now part of clinical templates.

Process:
M) The GP uses stroke and bleeding-risk scoring.
N) Commissioners wanted localized, cost-effective services.

The GPs also experienced adverse time effects regarding their wider role in OAC management, which was a factor with potential negative consequences for OAC care:

> GP5 (292-295) "…*you have to spend time with patients talking to them, and they want to know, and they've got a right to know* [about stroke-risk], *but again we are time starved and I think are we using the right type of things yeah*."

Here, the previously highlighted contextual factors concerning the GP role in identifying and managing new cases of AF, GP practice factor whereby the GP discusses stroke-risk with patients, and process, where the GP uses stroke and bleeding-risk scoring, gave rise to new mechanisms. These included, the changing GP-attitudes towards perceived bleeding and stroke-risk which affected their practice, and a belief that discussing stroke and bleeding-risk was now important. Therefore, for this GP, although these factors were now important, the time needed and available to enact this factor, affected the quality of care that he could offer. This had implications for concerns related to safety around OAC management, as GP4 elicited:

GP4 (74-89)" *…I think our system for warfarin is dramatically better than it was, there prescribing wise…Safety's one of the big ones for me,…when we've sat and done the reviews and looking through people's notes just how much more complicated it is than just a are they, are they in range 67% per cent of the time you know thinking about their, the vascular risk-scores and the HASBLED scores*."

In this example, GP4 recognised the main contextual factor of the nursing roles in managing the POCT clinics. However, this GP's lack of awareness of the processes surrounding the OAC management then became mechanistic for creating uncertainty, and concerns about safety. The cognitive dissonance that was reported, further related to a belief about the benefits brought by POCT on the quality of warfarin-patient care. This was evidenced by assessing GP knowledge about improvements in TTIR. The changing GP awareness thus re-enforced the GP's attitude towards the OAC change.

Systemization and communal appraisal thus reflected factors, involving the affects to undertaking any OAC change, on a clinician's existing role. However, numerous other factors also had to be balanced, which were generally more positive. This is discussed next, in terms of individual appraisal.

According to May *et al*. (2015) Individual appraisal involves:

"…*Participants in a new set of practices also work experientially as individuals to appraise its effects on them and the contexts in which they are set. From this work stem actions through which individuals express their personal relationships to new technologies or complex interventions*."

Figure 50. Systemization & Communal appraisal - Mechanisms affecting OAC care.

A) (Agency [belief]) Core duties are affected by role in OAC care.
B) (Structure [practice]) Changing GP attitudes towards perceived bleeding and stroke-risk affected practice.
C) (Agency [belief]) Discussing stroke and bleeding-risk is important.
D) (Relational) The GPs are not aware of the working processes surrounding the OAC management.
E) (Agency [belief]) There is a belief that near-patient testing has improved the quality of patient care.
F) (Culture [agency]) The increased frequency of INR-testing equates to better OAC care.
G) (Agency [belief]) There is a belief that near-patient testing has improved the quality of patient care.
H) (Culture [agency]) The LES enabled focus about AF and stroke-risk.
I) (Culture [agency]) Expertise in practice has improved the quality of OAC care.
J) (Agency [belief]) Near patient testing improved communication systems and enabled better decision-making in practice for the GP.
K) (Culture [processes]) There are economic processes and pressures (internally & externally) involved for the GP practice.
L) (Culture [structure]) There are changing clinical priorities which come from changes in funding.
M) (Structure [processes]) Funding reduced – The LES contract is subject to changes affecting affordability in practice.
N) (Structure [practice]) Pulse-checking for AF case finding.
O) (Structure [processes]) Pulse rhythm assessment is mandatory on all clinical

Individual appraisal was situated in several new contextual factors (Figure 51) and further represented, by two key new themes. These included, the recognition of improvements in quality of OAC care, protecting practice funding and unintended consequences of the LES.

Figure 51. Individual appraisal - Contextual factors affecting OAC care.

Role:
A) Nurses are now proficient in warfarin POCT.
B) NC provided in-house OAC expertise.
C) The GP maintains a practice management responsibility.

Practice:
D) Improved quality of warfarin management via LES.
E) Active AF case-finding.
F) The funding for the OAC LES changes.
G) DOAC drugs emerge for GP use.
H) Experienced staff with AF awareness.

Firstly, it was found that individual appraisal factors were again closely related to how the nurses had perceived GP support. These negative perceptions had resulted in creative and mutually beneficial methods of nursing peer support. Secondly, the GP experience of the OAC LES had also resulted in the realization of both improvements in the quality of INR management, and for expanding wider OAC practice, as explained by GP4:

> GP4 (27-30) "…*when we started doing the anticoagulation clinic it really set the tone for becoming more proactive in managing those others* [other AF patients taking and not taking warfarin]."

In reflexive monitoring, the frequency of in-house INR-testing was also mechanistic in improving the quality of OAC care. This was underpinned by the GP's belief about the effect of the OAC LES in enabling focus for AF and stroke-risk. Both mechanisms resulted in positive appraisal to support the ongoing change of OAC practice here.

Further evidence of experiential appraisal for the GPs related to the notion of expertise amongst the staff who were undertaking the POCT. This was deemed important for both quality of care and ease of practice, as described by GP3:

> GP3 (281-288) "…*I'd much prefer it the way it is now in-house where you know we know for certain whether someone's being monitored, and if I've got a query about it I know who to come and speak to…and speak to whoever's done the last monitoring and everyone seems to know what's going on*."

Here, GP3 recognised that nursing staff were proficient in POCT, whilst the NC was also now considered to exhibit expertise in OAC care. The value of in-house OAC expertise and the effects of POCT on both the quality of care and improvements to communication systems thus became positively mechanistic. This ultimately led to constructive outcomes for OAC care, particularly as developing expertise enabled the other clinicians to participate in OAC decisions.

However, funding was an ongoing important influence for the GPs. Contextually, within individual appraisal, the GPs' extended managerial role was also bound to the nature of LES

contracts via a process factor relative to the role and aims of commissioners, as GP3 explained:

> GP3 (424-435) "…*if that was the case and we knew the funding was going to be withdrawn, I'd be very much inclined to be saying refer them all back to the anticoag service this is what I would be suggesting, because at least then somebody is dealing with it, it might not be as good a service as it has we'd like, cos don't get me wrong I think the service the way it's run at the moment is much better, I'd much prefer to keep that, but if it's, if it's at the cost of the, the appointments, I think the appointments is the, the most important thing*."

Despite the positive effects experienced regarding OAC quality of care, in this example, three mechanisms arose threatening the continuation of the OAC service. Firstly, the presence of economic processes and pressures facing the general-practice influenced ongoing and future LES participation. Thus, changing clinical priorities were dependent upon and predisposed by available funding. Secondly, changes to existing funding agreements for the OAC LES also affected the OAC LES affordability in the practice. For example, the reduction in reimbursement from the initial contract for INR-testing was also a key concern for the GPs, who used the income to plan and manage the practice, as described by GP4:

> GP4 (353-367) "…*you know if they cut the funding stream…they say well we don't think this enhanced service is worth that amount of money and they chop it in half, how do you keep it going cost-effectively, or even as the or new novel agents come through and people go onto those a bit more and less on the warfarin, you lose that money and how do you make that money back again when you've got people employed on the back of the money? Those are my main anxieties at the moment*."

Furthermore, the experience of newer anticoagulants, also made them question, if this model of OAC care was sustainable, as GP1 elicited:

> GP1 (216) "…*yeah I, I think in five years' time we won't be running a, a warfarin clinic it'll be all of these* [DOACs]."

Each of these factors, were also mechanistic once activated and threatened the continuation of the current OAC provision using POCT.

In these examples, contextual factors now expanded to include a new practice component of the use of DOAC drugs, which itself, became a mechanism for OAC practice change. The economic pressures faced by the general-practice required balancing against the need for adequate and continued funding. Thus, this was now threatened by the expected rise in DOAC drugs use, which was not part of the OAC LES agreement. These new mechanisms produced uncertainty around continued and future OAC provision.

However, the existing experiential awareness, supported by the introduction of NOAC drugs, had changed the GPs' perceptions, of their role in OAC care. This occurred despite the LES's perceived extra costs. The experience of the OAC LES had also enabled other aspects of core-duties, including the changing nature of the AF-domain of the QOF:

> Practice Manager (224-237) "…*in many ways it* [the OAC LES] *set us in a really good position when AF was brought into the QOF* [10:55]…*than most practices because we'd done a lot of our data gathering through the warfarin clinic, so we already had a register, we already you know more than half of our AF patients are monitored here, so we'd another chance to score on all that, we were seeing those patients so it was great for us really, cos those patients….already in a recall system, so we were on the spring board ready to go really*."

Therefore, the OAC LES, had itself, created a structure mechanism whereby, LES participation had also enabled the practice to manage QOF changes to the AF domain. This enabled and sustained both the OAC and wider AF practice changes.

To summarise, several key mechanisms were found to exist in individual appraisal, which had positive influences, on maintaining and sustaining OAC practice (Figure 52).

Figure 52. Individual appraisal - Mechanisms affecting OAC care.

A) (Structure [practice]) Increased INR-testing in-house.
B) (Culture [belief]) OAC LES focuses AF practice.
C) (Agency [belief]) Internal expertise is valued.
D) (Culture [agency]) Internal expertise enables clinicians' OAC practice.
E) (Culture [agency]) Changing economic pressures of the general-practice.
F) (Culture [structure]) Changing clinical priorities occur due to changing funding.
G) (Structure [process]) OAC LES funding becomes less cost-effective.
H) (Structure [practice]) DOAC drugs are not reimbursed as part of the OAC LES.
I) (Structure [practice]) OAC LES experienced.

Although there was an acceptance of an improvement in the quality of OAC care practiced, there were also, ongoing concerns about the nature of future practice funding. These concerns seemed to override any future decisions regarding the continuation of the OAC LES. However, the unintended consequences of the LES had also helped the practice become further sustainable, in other aspects of the QOF. This is discussed next in the reconfiguration stage of the NPT.

May *et al*. (2015) described how in Reconfiguration:

"*…appraisal work by individuals or groups may lead to attempts to redefine procedures or modify practices – and even to change the shape of a new technology itself*."

Reconfiguration was situated within several contextual factors (Figure 53) and was reflected, not only by the embedding of a POCT system for warfarin, but also and more

Figure 53. Reconfiguration - Contextual factors affecting OAC care.

Roles:
A) All nurses are engaged in the OAC LES.
B) GPs decide to commence new OAC.
Practice:
C) OAC LES fully enabled.
D) OAC is widely promoted.
E) Risk-scoring is routinely used.
Process:
F) Pulse checking exists within clinical templates.

importantly, in the increase of AF case-finding and the promotion of OAC. Furthermore, OAC promotion had now also become led and directly managed by the actual general-practice.

Firstly, both sets of clinicians became more aware of AF and the need to identify it with efforts made to alter practice. For the nurses, this meant applying their experience of undertaking the OAC LES and attempting to transfer this to new patients, as explained by N2:

> N2 (240-249) "…*well picking them up* [new AF patients] *through doing the heart clinics, reviews, medication, and new patients who've come from hospital… now that now we've got better insight into saying we've got the clinic up and going, how would you feel to coming over, rather than having to visit the hospital etcetera*."

Contextually for the nurses, they were all now participating in warfarin care and recording pulse rhythms. A general belief now existed, of the value of OAC practice, which had arisen via experiencing the LES systems. This belief was further mechanistic in producing positive OAC outcomes of increased awareness, enhancing clinician confidence, to recruit new AF patients internally, for OAC assessment and management.

AF case-finding practice, exemplified the groups' awareness and confidence, as illustrated by the PM:

> Practice Manager (386) "…*now we have a record of something like the forty per cent of the practices' pulses that wouldn't have come about other than this* [the OAC LES] *– it's not a QOF-requirement… it was probably the PBC when they were looking, before AF became part of QOF…at maybe doing something around AF… they were asking how many pulses have you got recorded, our practice was by far, we were twice , more than twice of everybody else*."

In another example of reflexive monitoring, the contextual factors now included practice that showed that all clinicians were actively palpating pulses in search of AF. This was

embedded in processes that included pulse-checking adoption into all usual clinical templates.

New mechanisms supporting this context, such as the expectation and mandatory use of pulse assessment on clinical templates, enabled positive OAC outcomes, by promoting expectations, around clinical assessment that would eventually promote OAC practices here.

In addition to AF case-finding, the GPs also expressed a desire to initiate more anticoagulants themselves, which again, was not part of the initial OAC change, but a modification of practice, brought about through the embedding process itself, as depicted by GP3 and GP1:

> GP3 (593-598) "…*yeah cos what you don't want is somebody to have a stroke whilst they're waiting to be seen do you? and as long …I'm happy from HASBLED that they're a safe candidate I would start them* [on an anticoagulant] *yeah*."
>
> GP1 (55) "…*more recently then with the advent of CHADS scores and CHADS VASC…I think, it's focussed our mind a lot more and I think we're now, much more aggressive, I suppose, in anticoagulating people."*

Therefore, for the GPs, the context factors relating to reconfiguration had changed to include both roles of AF case-finding, deciding on OAC usage, and practice, incorporating risk-scoring into OAC decisions. Furthermore, in reconfiguration, three new key mechanisms also emerged that promoted and helped sustain the GP role in OAC care. These included the use of an established process of OAC initiation, a GP acceptance of use of DOAC drugs, and GP beliefs about how OAC initiation was now viewed as a role for the GP.

In summary, reconfiguration reflected five new mechanisms that enabled OAC practice (Figure 54) which were based upon the value placed upon experiential practice of both the GPs and nurses. The OAC LES and later QOF-AF changes were shown to be effectively embedded into the practice, although OAC practice was evolving away from warfarin use, with the increased use of DOAC drugs.

Figure 54. Reconfiguration - Mechanisms affecting OAC care.

A) (Culture [belief]) OAC nursing practice was now valued aspect of role.
B) (Structure [practice]) Value of OAC role promoted new patient recruitment to POCT.
C) (Structure [practice]) Pulse checking is mandatory.
D) (Structure [practice]) DOAC drugs have value.
E) (Agency [belief]) OAC initiation is a GP role.

The emergence of DOAC drugs reflected new practice in reconfiguration. Thus, methods for managing DOACs in the general-practice were unexplored.

5.5 Discussion.

Previously, there was a knowledge-gap, concerning the extent to which general-practices were involved in OAC decisions and management, reflected in the data about OAC usage. Therefore, GAPS-2, for the first time, explored the processes by which a general-practice engaged in OAC care, but also identified mechanisms that explained how OAC care was developed into routine practice.

The novel use of the NPT provided a theoretical structure which enabled a systematic analysis of the stages of embedding of the OAC changes of care into routine practice here. Furthermore, combining the NPT structural assessment with a realist analysis also enabled the identification of specific key CMO-configurations. These both enabled routine OAC care and allowed the development of OAC programme theory of OAC care in general-practice.

Embedding of OAC did eventually become routine, and several contextual challenges had to be overcome by both the GPs and nurses. The nature of these challenges varied as to the stages represented in the NPT and are synthesized relative to three key themes.

The first theme concerns the role of the clinician, and the specific actions required within that role. The second key theme involved the knowledge and skills required to participate in change, undertake the role, and have awareness of other roles in OAC care. Finally, underpinning this, were the agency notions concerning the clinician beliefs around factors relating to OAC care in practice.

The CMO-configurations presented were contingent upon the outcomes of previous CMO-configurations in prior aspects of the NPT. There is also recurring evidence to show how the

outcome of one or more CMO-configurations form the context of the next, in keeping with the ripple effects described elsewhere (Jagosh *et al*. 2015).

5.6 Study limitations.

Several limitations to this study are acknowledged. These may both affect and detract from the trustworthiness and transferability of the findings. Firstly, one limitation is the novel approach to the use of both the NPT and realist analysis of CMO-configurations used in this setting. As no precedents existed for these methods, there are also no available examples from which to make comparisons. Secondly, as this was a single researcher-led study, accuracy and agreement about coding and analysis could only be confirmed during regular supervision meetings. Therefore, it is possible that disagreement with coding and analysis may exist, limited by a methodological factor of the insider-researcher. Thirdly, this study was set in one general-practice setting experiencing OAC change, within a cluster of general-practices, of whom only a few eventually undertook the OAC LES. Practices which chose LES participation will have approached the OAC change differently depending upon the available resources and resulting CMO-configurations. Another key limitation of this study was the absence of the direct patient voice in the development of OAC systems. Although patients' stories acted as a mechanism for clinicians to change practice, there may have been different outcomes if patients were consulted directly about their experience of in-house and external OAC systems.

5.7 Implications for future research.

CMO-configurations need to be established in other general-practices for OAC services. This study provides the basis to examine the factors relating to roles, knowledge and agency elsewhere, as possible key themes of importance, for OAC practice. Future research that publish data about OAC use in general-practice should also consider the limitations of these OAC use levels, in respect of the extent of general-practice involvement and based upon the existence of likely specific, underpinning CMO-configurations.

Chapter 6.

6.0 GAPS-1 and GAPS-2 discussion and synthesis.

The previous chapters have examined the existing literature of general-practices' use of OAC in NVAF patients, a general practice's role in historic and more recent AF/OAC care and finally, how a general-practice implements AF/OAC care changes.

This chapter presents an original contribution to knowledge by synthesizing the findings of this thesis into a logic model that explains OAC change and AF patient pathways in a general practice. New knowledge is also presented, that for the first time, indicates the importance of nurses within an integrated care-model for the provision of AF/OAC care in general-practice.

This chapter presents a synthesis and discussion of the research findings from the literature review, GAPS-1, GAPS-2 that enabled the creation of a logic model. This model proposes three new key influential factors for OAC use in general-practice which are dependent upon an integrated model of care.

The literature review also highlighted the existence of heterogeneity of multiple factors that were either absolute or relative contraindications, which might lead to clinician confusion when it comes to OAC decision-making in practice. Some of these aforementioned factors were related to changing guidelines over time, although studies undertaken within the same period also had different inclusion and exclusion criteria based upon contraindications selected by the researchers and not explained by prevailing clinical guidelines. These inclusion/exclusion criteria and supposed contraindications to OAC used in the studies, do not explain decisions about OAC use in general-practice. However, the literature review also highlighted many examples of general-practice OAC underuse. Furthermore, those studies also identified several patient and practitioner factors that possibly related to OAC underuse in general-practice. Nevertheless, the literature review failed to fully explain the extent to which OAC use and underuse was attributable to general-practice decisions.

GAPS-1 therefore, mapped and analysed several factors involving the general-practice, in association with OAC use. The context of GAPS-1 involved a general-practice which was undertaking a cultural change of OAC clinical-practice. This change included the introduction

of both a new warfarin monitoring service and new clinical benchmarking for stroke-risk reduction in their AF patients. In GAPS-2, this was reflected in multiple CMO-configurations,[14] which affected how OAC was perceived and how clinical management around OAC was enacted.

GAPS-1 initially found that OAC rates of use were consistent with the inadequate levels of OAC use previously reported within the literature review for UK general-practice. However, a reflective mapping exercise of new AF patients between 2013 and 2017 indicated increased general-practice involvement with OAC. Nevertheless, both GAPS-1 and its subsequent review, also highlighted several factors not previously described concerning the general-practice's potential influence upon the OAC rates found. These factors included a wide range and variety of patient-pathways, with multiple influences on OAC outcomes. Furthermore, there was also a lack of clarity regarding the influences of specific roles of both, GPs and nurses, within this single general-practice setting. These factors are relevant to the interpretation of the general-practice OAC rates found in the literature review which portray inadequate stroke prevention in general-practice settings. GAPS-2 found that, in the culture and context of this general-practice, the nature of clinical roles were important determinants of OAC outcomes.

An evaluation and synthesis of GAPS-1 and 2 is presented as a refined logic model (Figure 55) and demonstrates three key constructs relative to general-practice roles in OAC care: 1) Knowledge, 2) Agency and 3) Function associated with clinical roles. These influences are generally underreported in papers and hidden in the context of the available evidence.

6.1 Knowledge.

The first key component of OAC roles concerns staff knowledge and its interactions with awareness around the concepts of OAC use, in general-practice. Data collection during GAPS-1 targeted the patients' journeys and the contact-points with clinicians. Further, focussing upon the diagnosis and treatment decisions in general-practice. Traditionally, when enacted, this has been a role led by GPs. Thus, most of the data in GAPS-1, which

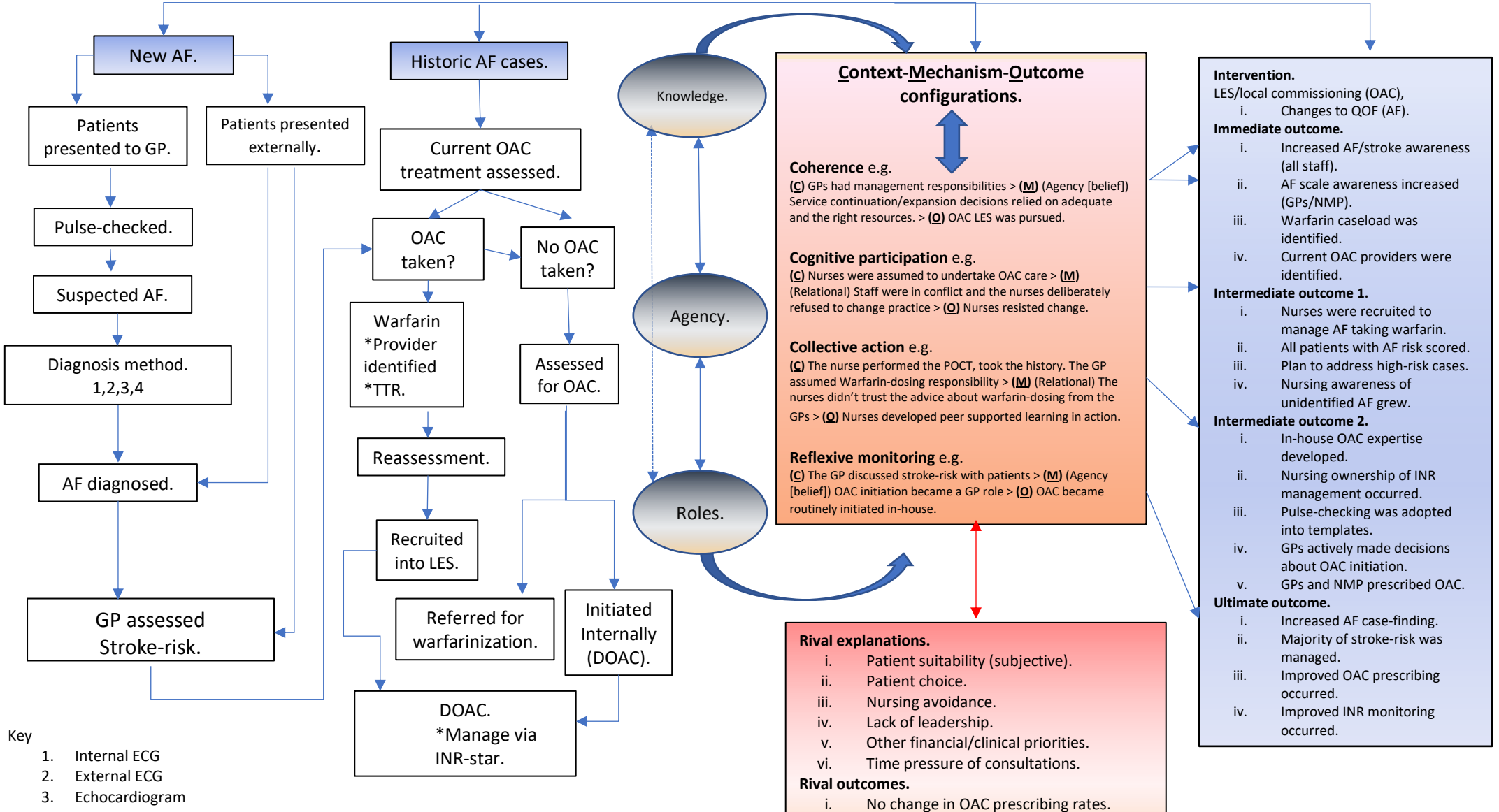
[14] Context – Mechanism – Outcome (see methods section, P.91)

frequently involved missing data fields, mostly reflected GP activity, rather than that of PNs. Therefore, GP knowledge-gaps, relative to previous clinical practices, are also reflected in the GAPS-1 Section-A findings. For example, it was found in 2013, that the GPs were the first clinicians to code the diagnosis of AF following initial investigations, in a quarter of all the cases. It is doubtful that most of the GP-coded patients were diagnosed by the GPs per se. Rather, they relied upon the externally-reported ECGs to confirm an AF diagnosis, which itself has implications for early OAC treatment. However, of all the antithrombotic decisions taken, involving both the GP-diagnosed (initially coded) patients and those diagnosed elsewhere, the GPs were only involved in less than 30% of all stroke-risk reduction decisions (Table 36, P.146).

This notion, in relation to knowledge, was confirmed in GAPS-2 by GP2 (119-130, P.168). Here, the GP expressed difficulties in judging suitability for warfarin use based on his beliefs about age and drug-use risk. However, as knowledge about OAC grew, so did improvements in OAC rates. Improved OAC outcomes across all AF patients with whom the GPs had input was found in the analysis-B, between 2014 to 2017. This improvement occurred after the general-practice had implemented the OAC changes and included a trebling from 24.9%, to 78.6%, in the percentage of GP AF diagnosis rates; a near doubling of the use of OAC, from 51.8% to 91.1%, and similarly, a substantial increase in general-practice OAC decisions, from 29.4% to 51.8% (Table 38, P.151).

Knowledge-gaps around making decisions about warfarin may have contributed to most GP decisions regarding antithrombotics, favouring APL. Similarly, in the section B) analysis, new knowledge about the increased effectiveness of OAC, including DOAC drugs, may be responsible, for the declining use of APL.

Figure 55. Logic model: OAC change and AF patient pathways.



The methods that the GPs employed to guide their actions and non-actions towards OAC decisions also reflected personal knowledge biases, as shown within the initial findings of GAPS-1. For example, the GPs regularly made referrals to cardiologists to ask about the need and or suitability for, or request, possible initiation of warfarin. Most (72.1%) of these referrals included GPs questioning the patient's suitability for OAC. However, these referrals did not routinely include GP-made stroke or bleeding-risk assessments, as summarised in Table 28 (P. 132).

However, as knowledge and awareness grew about the importance of AF in stroke and the use of risk-assessment tools, OAC uptake almost doubled, from 51.2% in 2013, to 91.1% in 2014-17 (Table 38, P.151), as GP1 explained in GAPS-2:

> GP1 (55) "…*more recently then with the advent of CHAD scores and CHADS VAS* [colloquial]…*I think, it's focussed our mind a lot more and I think we're now, much more aggressive, I suppose, in anticoagulating people*."

The GPs continued to ask advice about the need for OAC from specialists in over 30% of the cases of patients that they had diagnosed with AF. However, as OAC knowledge developed and became established within the practice, the GPs also started to refer to the NC for assessments about suitability for OAC, occurring in over 16% of GP-diagnosed cases. However, nursing knowledge about AF and OAC management also had to be developed, occurring as part of the OAC practice changes, as indicated in GAPS-2. Furthermore, knowledge-gaps in relation to AF and OAC, also affected how the nurses approached OAC practice change.

For the nurses, the lack of knowledge surrounding AF was shown in GAPS-1 by the scarcity of evidence indicating their role in the AF patient journey. On further reflection, the nurses lacked basic knowledge around the association between AF, stroke-risk and OAC use. This lack of awareness caused further distancing of the nurses from any roles involving OAC care, as highlighted in GAPS-2 by N4 (54-61, P.173) when discussing undertaking the task of $CHADS_2$ risk-scoring. Therefore, the emergent AF cohort constituted a new clinical challenge for the nurses, driven in part by QOF-requirements. This included potential or undiagnosed patients and new AF patients which they would face in routine consultations and be

expected to record (at least) a $CHADS_2$ risk-score. Undertaking the $CHADS_2$ risk-scoring was an automatic computerised function to be "*clicked*" within the electronic patient record, which required no knowledge to perform. Thus, for the nurses who might undertake the $CHADS_2$ risk-scores, without understanding the basic association between stroke-risk and AF, the function of scoring became itself, a meaningless QOF-task.

Furthermore, the lack of understanding around AF and OAC also affected the ways in which the nurses considered changing their practice-roles, taking account of AF and the new OAC LES. Both, the GPs and nurses had perceived warfarin to be a dangerous complex drug. However, the nurses also considered warfarin-care to be a role requiring expert knowledge. Moreover, nursing knowledge-gaps about the clinical importance of the OAC changes, compounded negative attitudes, led to resisted engagement, as elucidated in GAPS-2 by N2 (42-43, P.176), who described no knowledge of the requirements for this new OAC practice.

However, the QOF changes captured in GAPS-1, which included requirements to measure stroke-risk and the associated payments for targeted OAC treatments, did raise the awareness of the practice to the extent of stroke-risk and OAC undertreatment. Secondly, although not apparent in the data of GAPS-1, the QOF changes also resulted in income loss to the surgery resulting in the practice considering the new OAC LES. This GP-awareness resulted in the need to explore new pragmatic ways of working and the creation of new nursing roles.

It emerged in GAPS-2 that knowledge was, again, a key factor in how these changes occurred. For example, the GP-knowledge of both the financial implications surrounding QOF changes, the opportunities associated with the OAC LES, plus the clinical benefits of changing OAC practice, were factors that drove the GPs to pursue nursing-role change. This GP knowledge affected the nurses, who themselves, lacked any awareness of both the need for, and means to change OAC practice.

Furthermore, nurses also understood that there were financial implications for undertaking this change but believed that this was only beneficial to the GPs, as described by N2 (103-110, P.179). This imbalance of knowledge created friction not only between the GPs and nurses, but also amongst the nurses themselves. This friction centred upon the HCA role,

the staff member with the least experience, who was encouraged by the GPs but discouraged by the registered nurses to develop the new OAC role.

The failure of the GPs to persuade the practice-nurses to undertake the OAC role led the GPs then attempt to utilise HCA staff by promoting a supposed "*task-based*" and simplistic "*GP-led*" OAC management system, as explained by N3 (68-81, P.181). However, it was the knowledge gained from experiencing the development and initiation of the OAC service by the HCA, which enabled the other nurses to seek to participate in the OAC change. Furthermore, increased awareness of AF and OAC amongst the nurses also increased AF/OAC activity.

The GAPS-1 analysis between 2014-17, showed that new knowledge enabled the development of new roles for nurses in AF diagnosis and OAC decision-making, complementing GP-activity (Table 39, P.152). These new roles became a referral resource for the GPs and enabled OAC decisions to be made within the practice. Furthermore, it also helped to grow nursing engagement in the OAC LES. Once the OAC LES had become established in the practice, the GPs eventually had no role in the OAC LES management, as N3 [44-53b, P.195] explained in GAPS-2. However, like elsewhere, the specific barriers to managing the increasing use of DOAC drugs were only now being experienced and not realised fully by the GPs (Barnes *et al.* 2018).

To summarise, in GAPS-1, the key function of awareness linked to a lack of knowledge about the scale of AF and stroke-risk was represented in OAC undertreatment of AF patients. Furthermore, there was uncertainty about the importance of, and of actual GP knowledge about stroke/bleeding risk weighting when the GPs made decisions to delegate responsibility for OAC decisions to other hospital clinicians.

Secondly, the roles of nurses in AF patient management were not clear in GAPS-1 but became so in GAPS-2, suggesting a previously low level of engagement. Nursing knowledge about the nature of AF and its role in stroke-risk is essential, if a practice approach to stroke-risk-reduction is to occur. In GAPS-2, raising awareness of the need to undertake warfarin management (involving the LES) both created new roles for nurses and later developed nurse awareness of the importance of AF in the risk of stroke, resulting in opportunistic nurse-screening observed in GAPS-2. However, GAPS-1 failed to identify nurse activity, and

GAPS-2 identified a lack of nurse-awareness regarding the need for AF change, and a wide knowledge-gap concerning stroke and AF practice. Thus, the experience here also suggests that the methods for using and sharing knowledge by clinicians are also vitally important in addressing OAC practice management changes. These methods may also be complicated by clinician motives, resulting in ranges of willingness to act, or agency, to be discussed next.

6.2 Agency.

The second key component of OAC roles concerned agency, which has been defined as:

"*…Ability or capacity to act or exert power; active working or operation; action, activity."* (Oxford English Dictionary 2019).

Furthermore, according to Bhasker (1979) from a realist perspective, agents and thus their agency are explanatory causal mechanisms influenced by various social conditions, and this was observable in the present study.

GAPS-1 showed that nearly half of all AF patients were not treated with OAC, leaving many patients at risk of a stroke. This suggests that when consideration for OAC was made, the GPs were not willing able or motivated to make the decisions about OAC themselves, instead being more likely to delegate OAC decisions to specialists. These motives must of course be considered within a historical context. To clarify, the OAC rates of the AF caseload here were based largely upon decisions made over many years and often by specialists external the GP practice. Furthermore, there were no active systems in place for focused regular GP reassessment of OAC care; such was the clinical culture at the time of GAPS-1 data collection.

GAPS-2, however, found that both the GPs and the nurses held several shared and independent motivations towards OAC care (Table 41). The motives found, sometimes shared, were contextually mechanistic in producing outcomes which resulted in changes of OAC practice but were also the products of the knowledge previously described. Furthermore, the motives found in GAPS-2 were also complicated by competing motives and by the interactions of the non-shared motives of other staff.

Table 41. Shared motives for OAC use and change.

Roles.	Driving motives.	Barrier motives.
GP.	Fear of litigation. Quality of care concerns (OAC) CQC, prescribing. Financial rewards (QOF, LES).	Effect on workload. Financial costs.
Nurse.	Learning opportunity. Ownership. Quality of care (patient experience.)	Fear of litigation. Effect on workload. Creating wealth.

For example, the GPs had first-hand knowledge of practice complaints in relation to warfarin management and numerous stimuli, including the QOF and the CQC. This GP-held knowledge raised GP awareness and/or, expectations for improving the quality of AF and OAC care. Whilst these motives were early enabling factors in GAPS-2 for the GPs, different motives became applicable at different time points in the change process. These factors also became active when knowledge (previously described) became established.

This was exemplified by the nurses when they were initially fearful about engaging in OAC management through fears of litigation about taking responsibility for INR-testing and dosing. However, for the nurses, experiencing their roles in providing OAC care became mechanistic in changing individual nurse attitudes to the OAC change. After enacting the nursing roles, the nurses were able to recognise the importance of the change, on the quality of care they provided. This new AF/OAC awareness provided further evidence that outcomes can influence motivation.

Conversely, negative effects of OAC change on both the GPs' and nurses' workloads were also found to be disabling factors in initiating and sustaining OAC practice change. A further example involved the early OAC change recorded in GAPS-2. In this example, the nurses felt that the GPs were simply "*dumping*" and thus, increasing their burden of work. These views were also shared some GPs who were wary of agreeing to undertaking a new AF-service (GP3 [323-332], P.186).

Furthermore, latterly, it was also a GP's concern that the creation of AF-nursing-expertise had also negatively impacted on the GP's own workload. Therefore, the value of having developed a new OAC service, and the positive effect on increasing the quality of care, had to be balanced against key routine practice motivating factors. However, the notion of

dumping was also related to sustaining provision of services from a GP financial perspective. This is reinforced by external pressure of impact assessments that show an overall health expenditure benefit for stroke prevention of GP-AF diagnosis and optimization of OAC uptake in high risk patients, whilst also continuing to fail to appreciate the management costs of AF management on a GP practice's clinical capacity and associated costs (Orlowski, *et al.* 2020).

Financial drivers themselves could be both interpreted as negative and positive motivational factor for the nurses and GPs in GAPS-2. For example, an assumed financial gain for the GPs, was an also important factor in the nurses' resistance to OAC changes in practice (N1 [27-33], P.177). Conversely, this was a positive motivating factor for the GPs, until the financial gains ceased. This suggested that practice finances had greater priority over the increased quality of care that had become established, as explained by GP3 (424-435, P.220).

However, for the nurses, most resistance to OAC change had initially emerged due to attitudes about OAC role complexity in primary care not just the benefits of financial gain for the GPs. Therefore, nursing attitudes towards introducing what was deemed to be a highly contentious role change, was not only based upon many misconceptions about OAC care, but also used to promote a lack of desire to take on more extended roles to benefit their GP-employers. A similar finding has also been highlighted in a systematic review of the literature (Riisgaard *et al.* 2016) of previous papers that have examined the relation between job satisfaction and role, task delegation in general-practice (Maisey *et al.* 2008; McGregor *et al.* 2008; Cousins & Donnell 2012).

However, the initial key enabling motivation components found in GAPS-2 for nurses concerned the opportunity for and the benefits brought through learning and enacting a new role in OAC. These were described in terms of skills development, improved nurse-patient communications and increased job satisfaction for the HCA, as summarised by N4 (304-316, P.163). Such findings that have described professional development in relation to changing roles, as key to nurses' satisfaction in general-practice elsewhere have also been previously described (McGregor *et al.* 2008; Cousins & Donnell 2012; Hegney *et al.* 2013).

In summary, the agency and motives reported in GAPS-2 which was derived from knowledge and awareness of specific contextual factors, existed for both clinician groups.

Furthermore, GAPS-2 also showed that certain motives were activated at specific times and affected by experience of OAC change. However, the key factor linking all the emergent motivations related to roles. Moreover, how roles operated and were incorporated into the existing and changing, practice systems.

6.3 Function.

The third key component of roles related to function, specifically in relation to understanding the nature of and expectations surrounding the roles undertaken in OAC practice. The data in GAPS-1 did not capture any work that was undertaken in delivering AF practice by nursing staff. This is also overlooked within the literature where nursing roles are seldom mentioned in general practice settings. Therefore, the rates of OAC use within the current literature and those rates depicted in GAPS-1 may be mostly representative of GP role functions.

However, in GAPS-2, a summary of both GP and nursing role activity (Table 42), highlighted how function might also produce mechanisms that affect could OAC outcomes.

Table 42. Role functions.

	Pre-GAPS-1	GAPS-2
GP.	Clinical assessment: - Diagnosis. - Referral. Medicines management: - Initiating medicines. - Repeat prescribing. Organisational: - Employment. - Financial. - Quality of care. Managerial: - Delegation. - Accountability. - Training.	(Additionally) Change agent.
Nursing.	Clinical assessment (AF): - Blood testing. - Diagnosis (ECG). ¥,€ - Pulse-checking.	Change agent. *,€ Clinical assessment: * - Diagnosis. - Referral. Medicines management: * - Initiating medicines. (OAC) - Repeat prescribing. Medicines management: *,¥, € - INR-testing, warfarin-dosing. Managerial: *,¥, € - Formal and informal clinical supervision.

*(NC), ¥ (Practice Nurses), € (HCA)

Consequently, GAPS-2 was able to determine that nursing staff had minimal influence over the OAC outcomes found in GAPS-1, as their role functions did not generally affect the AF patient group. For example, as nurses previously had no explicit role in OAC, they were limited to undertaking task-based roles at the request of the GPs, such as ECGs and blood sampling. Furthermore, it was not until or after OAC structural changes began to emerge that nurses became involved in AF care at all.

Thus, In GAPS-2, it was GP-agency concerning both organisational and managerial factors, which led to nurses changing roles. Specifically, GPs were concerned with raising the quality of care within the practice and with the aim of ensuring continued and adequate practice financing to maintain employer responsibilities to their staff and cited as a key reason to change OAC practice, by GP3 (445-464, P.179).

However, GP managerial responsibilities that included the allocation of nursing roles generally, were also found to be a point of contention, fuelled by previous nurse role change experiences involving baby clinics, as explained by N2 (702-707, P.192). Notably, the GPs were allocating a very complex new responsibility, as if it was something nurses can "*just fit in*" and it was fair to say, that their lack of research into these changes and how these may impact on the nurses undertaking the new roles, was staggering. This GP-attitude to nurse-role delegation relates to what has been found elsewhere, as the "*professional ignorance*" of doctors, who do not recognise the importance of interprofessional shared decision-making as an important factor in promoting teamworking in general-practice (Szafran *et al.* 2018).

However, the nursing ignorance as to the need for OAC change involving new nursing roles development was also underpinned by a lack of nurse function in the managerial aspects of the general practice. The nurses had no organisational or managerial roles in the practice, and they were not involved in the early discussions about bringing the OAC LES into practice, which consequently produced negatively acting mechanisms for OAC change. Therefore, it was only the opportunity for role-development and new learning which enabled the first nurses to engage in the proposed practice changes.

The opportunity to learn and diverse into new skills was an independent motivating role-function factor, which was itself empowering for the nurses willing to engage in the AF/OAC

changes. Empowerment occurred due to the eventual development of nursing expertise of both the HCA and NC in an area of clinical practice previously deemed to be an external expert role function. Furthermore, these opportunities would also eventually lead to the emergence of OAC expertise of the other nurses. As such, the NC became a referral point for both GPs, who were actively case-finding new AF patients, and nurses, who later became engaged in the warfarin POCT, eventually developing the expertise to manage patients independently of the GPs.

Furthermore, after GAPS-1, the nursing-work done outside the LES also changed in a variety of active roles in caring for new AF patients such as, routine pulse checking and independently instigating ECGs. However, it was the informal ways in which team-working and supervision evolved that enabled the nursing roles to flourish. For example, new roles for nurses required a foundation of support that wasn't necessarily available from their busy GP-colleagues, as depicted by N3 (392-402c, P.200). The recognition of role factors was therefore key to interpreting both the OAC use in GAPS-1 and the nature of CMO-configurations in GAPS-2. This knowledge around collaborative practice is key in developing a future general-practice OAC intervention for change.

Conclusion.

The background of this thesis included the context of a recognised undertreatment of AF patients at high-risk of stroke, which was confirmed in GAPS-1. However, the extent and effectiveness of the general-practice roles in OAC treatment was not understood. This general-practice underwent organisational changes that included practice orientation to the extent of AF, and the subsequent identification of stroke-risk. Patient mapping identified a cohort of AF patients for whom the general-practice could, and should have, been managing using OAC, with greater effectiveness. Furthermore, despite the opportunity, the GPs' roles were often passive in decisions about OAC, with minimal input from practice-nurses. Thus, knowledge, agency and functions of historical roles, were identified as possible barriers to OAC care. Conversely, introducing new OAC organisational change, also involved knowledge, agency and function adjustments of all roles, to enable action in the promotion of OAC change and to increase the effectiveness of OAC care management here.

The findings in both GAPS-1 and GAPS-2 suggests that historic OAC use recorded in general-practice, is strongly influenced by secondary-care. Furthermore, contractual changes have prompted attention and raised awareness as to the need for general-practice to engage with OAC treatment. However, contractual and nationally guided AF/OAC care expectation of general practice requires a practice approach to be effective that is not represented in the current literature.

Although the findings in this thesis may not be entirely representative of other general-practices, many of the findings will be transferable, as other general-practices endeavour to develop their own OAC changes in practice. Developing future and effective general-practice OAC change will therefore require the application of behavioural strategies in respect of the possible CMO-configurations, to be discussed in the final chapter.

Chapter 7.

7.0 Thesis discussion.

This chapter summarizes the findings from this thesis Investigating OAC underuse in general-practice and presents a new integrated care model for AF and OAC care in general-practice. The model, which is reinterpreted the through a lens of physician-nurse professional dynamics, also presents new knowledge about AF/OAC systems development and embedding into routine practice. Finally, this chapter discusses the thesis limitations, implications for general-practice and further research.

This thesis has also presented a new analysis of the state of GP-managed OAC treatment for AF patients at risk of a stroke, from the realist standpoint, which answers the question:

"…*what is it about OAC and AF care work, that works for whom, in what circumstances and why?*'' (Pawson & Tilley 1997. P.56-59).

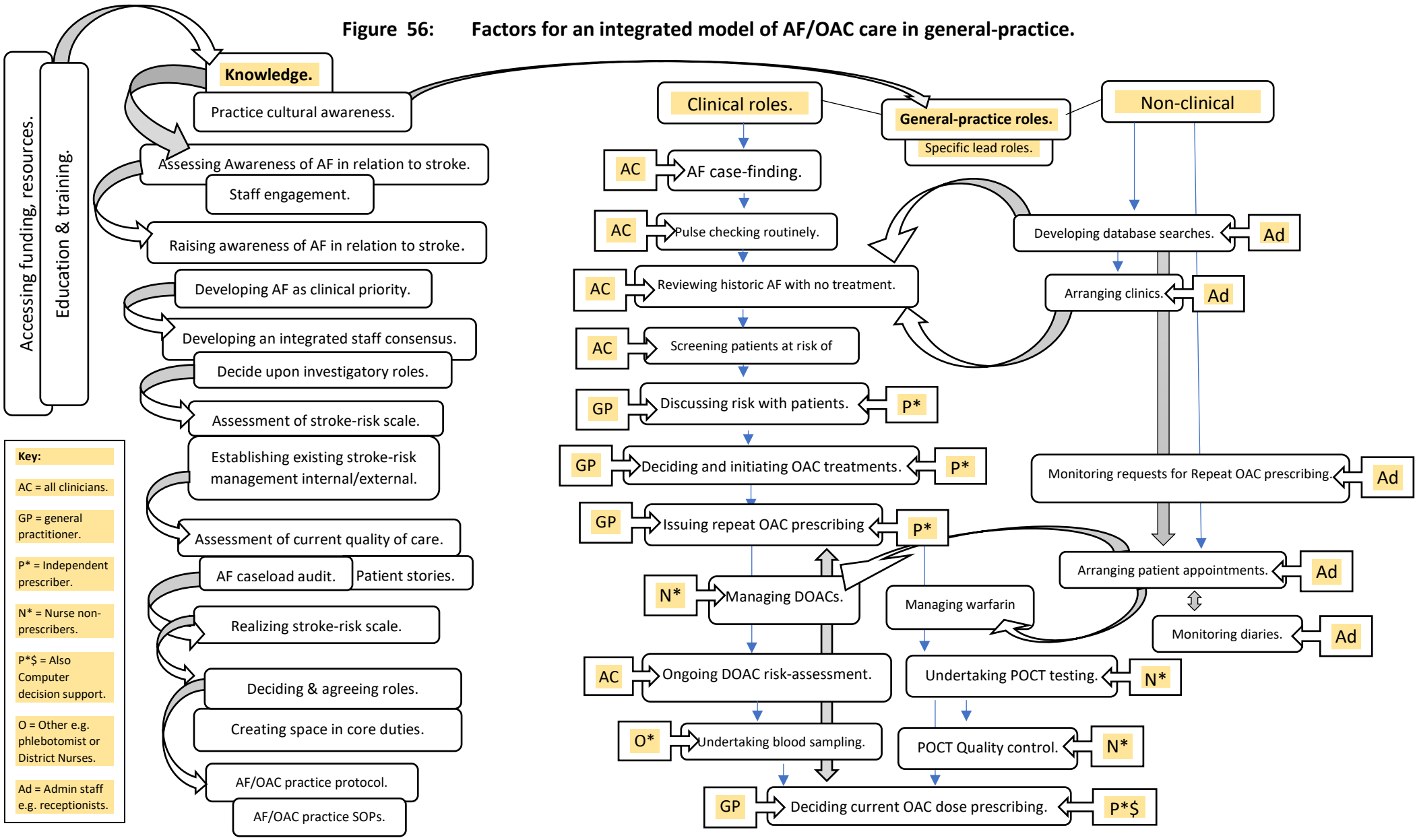
The successful embedding of an approach to AF and OAC management required an integrated care model. This model was based upon several important patient-specific, clinician-specific and organizational factors that were potential mechanisms for either preventing or promoting OAC use in this general-practice. These factors, summarized in Figure 56, may be relevant to other general-practices and will be discussed next.

The findings showed that from an initial position of both historic underuse of OAC and limited general-practice input into OAC decision-making in AF patients, OAC care has now become embedded into routine daily general-practice here. Over the time period of this research, both the GP and nurse roles have been transformed by numerous mechanisms. These mechanisms have either directly or indirectly, enabled changes in AF/OAC care in this general practice.

This thesis contributes to the knowledge about OAC use in several ways. Firstly, the previous literature had assigned rates of OAC use directly to general-practices by the data-collection methods used, without verifying the extent of the general-practice roles in the rates reported. Moreover, the previous literature also makes no distinction between general practice, the specific roles of GPs or nursing staff and the rates of OAC use reported.

Therefore, this thesis has for the first time, identified the contextual themes by which OAC rates can be attributed to the general-practice. Secondly, this thesis used existing validated methodologies of realist-evaluation and the NPT in a novel way to investigate deeper into the nature of general practice use of OAC. This novel use of methodologies enabled a different perspective compared to the usual approaches to analysis of OAC use in general practice. Hence, expanding both the repertoire and applicability of realist-evaluation and NPT further within general-practice settings.

Figure 56: Factors for an integrated model of AF/OAC care in general-practice.



Thirdly, combining the NPT and realist approaches has enabled the development of new program theory, presented in a logic model (Figure 55. P.230). This logic model explains general-practice OAC use, which can be used in future studies for testing research transferability. These contributions to knowledge will now be discussed in more detail.

Explaining previously observed OAC rates in general-practice involved exploring the actions of clinicians in context. This explanation was achieved by firstly mapping patients' journeys and then by investigating OAC change processes. NPT provided a theoretical structure that enabled a systematic analysis of both historical OAC care and the stages of change of new OAC practice. Also, combining the NPT's structural framework with a realist analysis enabled the identification of specific, key CMO-configurations.

The CMO-configurations that have been presented are thus contingent upon the outcomes and CMO-configurations in the previous aspects of the NPT. These findings suggest recurring evidence to support the notion of CMO-configuration ripple effect (Jagosh *et al*. 2015). The culmination of these new CMO findings thus supported the production of new program theory for routinized OAC care in this general-practice.

Starting from a cultural context of minimal general-practice input into AF and OAC care, several contextual challenges required overcoming by both the GPs and nurses, to ensure the eventual embedding of OAC into routine practice. Any future OAC/AF intervention will also need to establish contextually sensitive factors, as suggested in Figure 56. The nature of the challenges identified in this thesis varied as to the stages represented in the NPT, which are synthesized thematically into three themes: Roles, Knowledge and Agency. The first theme concerned the roles of the clinicians and the specific actions required within each role enacted. The second theme involved the knowledge and skills required to participate and undertake specific roles which are fundamental to any future OAC/AF intervention (Figure 56). Finally, underpinning this, were the notions and beliefs about agency which concerned factors relative to the clinician's part in OAC practice, all of which will be discussed next.

Establishing OAC/AF knowledge and knowledge gaps are also critical in planning for any future OAC/AF intervention for general-practice (Figure 56). The fundamental knowledge gaps found in this thesis that affected OAC rates concerned GP OAC prescribing and nursing

awareness of AF and stroke-risk. For example, the context for this thesis depicted OAC use that was represented by historic warfarin prescribing, limited by a lack of GP activity in actively prescribing it. Furthermore, OAC use was limited by which patients the GPs referred for OAC consideration, which mainly related to patients' ages. Whilst, a similar knowledge gap also existed for nurses, who having previously lacked the knowledge about AF, will have routinely missed opportunities to screen patients for undiagnosed stroke-risk.

However, awareness of stroke and bleeding-risk has grown in this general-practice. Subsequently, as seen elsewhere, interventions such as clinician education and guideline-driven and protocol-based OAC care have been successful at increasing OAC prescribing here (Prichett *et al*. 2019). The resultant improvements in both GP-AF case-finding and DOAC prescribing here are like other findings in the UK (Lacoin *et al*. 2017; Apenteng *et al*. 2018). These increases have occurred relative to the introduction and increased use of DOAC drugs in all ages, but especially in older patients (Mitchell *et al*. 2019). But are not necessarily linked to decisions about bleeding risk, even in patients with severe kidney disease (Potpara *et al*. 2020), which is itself has been previously cited as a potential CIS for OAC.

Furthermore, these outcomes, which were delivered via practice changes, also relied upon the collaborations between GPs and nurses working and learning new clinical-practices together. Therefore, any future proposals for OAC/AF interventions must also consider any exiting or prior OAC/AF knowledge and how changes to practice might affect practice roles integrating, staff consensus and relationships (Figure 56).

Much of the research that has been previously undertaken about doctors and nurses working together to enact change has occurred under the auspices of inter-professional collaborative practice (World Health Organisation 2010). Collaborative working between health professionals, benefits patients, enhances health outcomes and healthcare systems, by optimizing care coordination and the working context, which can reduce healthcare burden (McInnes *et al*. 2016). However, inter-professional collaboration in primary care is a highly complex phenomenon with many underlying components (Morgan *et al*. 2015) such as, team structure and team process (Xyrichis & Lowton 2007), ad-hoc communication and parallel caseload working (McInnes *et al.* 2017; Russell *et al*. 2018). Furthermore, inter-professional collaboration in primary care is also contextualised within the historic medical

domination of healthcare systems (Willis 2006; Huby *et al*. 2008) resulting in an imbalance in power within the relationships between doctors and nurses, with subsequent nursing subservience (Stein 1967).

Formerly, doctors have exerted power over the nursing profession via nurses' reliance upon both education and employment provision by doctors (Keddy *et al*. 1986). However, nursing has evolved in pre-and post-registration education and in professional practice so that nursing is now an autonomous and independently accountable profession, working as peers with medical colleagues. Yet this is not the case in all settings, particularly in general-practice, as GPs continue to both directly employ and oversee general-practice care provision by nurses.

The delegation of tasks and responsibilities to nurses thus demonstrates patient management, with clinician expectations of doctors' co-ordinating roles within health care teams (Negus *et al*. 2010; Szafran *et al.* 2018). However, new PN roles, such as those involving OAC care, delegated by GPs via ad-hoc negotiations, affect the uncertainty and clarity of expanding roles (Merrick *et al*. 2012). Furthermore, such delegation may also affect the relationships between both clinician types, which are a key component for good collaborative-working (King *et al*. 2017). Therefore, the historic power imbalances and influences of GPs continue to shape the direction of clinical services and with it, the nature of nursing roles in general-practice. And yet, there continues to be a reported disregard for the roles that nurses could play despite GPs failing to adhere to DOAC management guidelines (Murphy *et al*. 2020).

Consequentially, OAC service changes that involve nursing may always be problematic, unless there is importance placed upon collaborative working, or relational co-ordination (Gittell *et al*. 2013), and a reciprocal supportive method for focusing on the change (Gittell 2002). Or, as Gittell (2006) succinctly states:

> "*Coordinating work through relationships of shared goals, shared knowledge and mutual respect."*

The organisational culture within general-practice is complex and is comprised of multiple factors. Therefore, awareness of these factors is necessary in developing an integrated

model for OAC/AF care (Figure 56). A demonstration of difficulty in making and sustaining change of OAC practice here arose because of the nature of the organizational culture. This also included how clinicians related and communicated with each other, based upon their professional identity (Gittell *et al.* 2013; Szafran *et al.* 2018). The GPs decided between themselves the rationale for the initial change and did not involve the nurses, who were then instructed to do something that they knew nothing about - an example of the marginalization of nursing in the policy-making process (Coombs 2004). Nursing's exclusion thus denied the benefits from nurses participating in initial OAC change discussions, as a demonstration of their value in team-working, team vision and shared goals (Mulvale *et al*. 2016). Therefore, initially, the organisational structures described included a lack of relational co-ordination that disabled change work and further promoted silo-type working (Gittell *et al*. 2010). These structural factors were responsible for affecting the quality of care and are something that requires dismantling in clinical practice combined with the education of clinicians (Selleck *et al*. 2017). In the context within this thesis, education involved both formal and informal learning. But, more importantly, education was required by whatever means to empower the clinicians at different stages of the AF/OAC changes to enable understanding and decision making about clinician agency. Therefore, it was both the content of the education and the methods by which it was delivered and by whom, that was key to mechanising AF/OAC change.

For example, interventions based around integrated OAC/AF care models also need to consider specific role aspects (Figure 56). However, misinterpretations of clinician roles and responsibilities are also common and important factors that prevent the formation and consensus of team-goals, thus constraining effective collaboration in practice (Xyrichis *et al*. 2008; Szafran *et al.* 2018). However, the notion of relational co-ordination also assumes that there is consensus between individual clinicians and across clinician groups as to the meaning of working collaborations, which has also been found to be culturally dependent (House & Havens 2017). Furthermore, personal beliefs about working relational collaboration are, themselves, influences on practice culture that affect OAC changes (Lee *et al*. 2014). For example, the PNs considered collaboration to involve them making money for the GPs. This contrasted with the GPs' stated motives, which were to ensure the practice's

financial stability, protecting employment of the PNs and others and enabling improvements in quality of OAC care.

Therefore, establishing the individual and cultural nature of relational collaboration involves understanding more generalised perspectives and components for collaboration in health care. For example, a literature review, concerning collaboration in health care, identified several domains that included communication, trust, respect, power and task characteristics, as reoccurring themes to interprofessional and interorganizational collaboration (Karam *et al*. 2018). In another literature review, the importance of recurring, frequent, shared and informal communication was the key factor, enabling interprofessional collaboration (Morgan *et al*. 2015). Furthermore, as the GP lead roles are based upon power, there needs to be more focus on developing the necessary skills when using their power and authority, whilst also having awareness about the effects of decisions they make, on the other healthcare team members, to reduce change conflict (Szafran *et al.* 2018).

Each of these themes has been evidenced within GAPS-2, and these were also shown to hold both contextual and mechanistic qualities, affecting OAC changes here. However, Karam and colleagues' (2018) review proclaimed the centrality of communication in both linking and directing the key concepts of collaboration, to create shared values amongst collaborating clinicians. However, the creation of shared values is/are also underpinned by the influence of the motives and power of those conducting the communications. Thus, power struggles, representative of the relationships between the nurses and doctors, also epitomized their different hierarchical, social, and economic levels within the practice (Dey *et al*. 2011). Furthermore, perceptions about power and power struggles are also mechanisms which create further negative attitudes and barriers for collaboration (Dey *et al*. 2011). This was again typified in the HCA's experience of a "*tug-of-war*" state. Here, on the one hand, she was being directed by her GP-employer to begin a new role. Simultaneously, she was under pressure not to accept it based upon the fears of her registered nurse colleagues.

Interagency collaboration is also dependent upon situational factors, including awareness and task characteristics, which comprise scope, complexity and uncertainty (Ervin 2004). Furthermore, structurally, parallel workloads are also common, in this study and elsewhere, and involve nurses and GPs working alongside but separately to each other (McInnes *et al.*

2017), with GPs mostly expecting to assume lead roles in practice (Szafran *et al.* 2018). This again highlights the need for assessment and awareness of practice culture and understanding of the potential impact on knowledge of OAC/AF care when planning future OAC/AF interventions.

In GAPS-2, there was a complex lack of nursing awareness about the need for OAC change, or about their role in enacting POCT. Furthermore, in the later domains of the NPT, both GPs and nurses demonstrated a lack of awareness about each other's roles, both within the OAC care and the wider general-practice. Two important examples are offered here that stress the need for GP awareness around the role and scope of PNs undertaking OAC care. Firstly, in skill-set workability of the NPT, nurses required clinical advice and support, yet this was not provided by GPs (Almost *et al*. 2016); nor did the GPs show any understanding of the nurses' roles or of the nurses' clinical concerns in their actions. This is an important factor in promoting effective collaboration and increased quality of care between clinician groups (Borrill *et al*. 2000). Secondly, in reflexive monitoring of the NPT, GPs viewed the NC's role as being an inefficient use of time which affected their own workload. This was shown in the lack of GP-awareness about the role and scope of the NC in the LES and wider evolving OAC management. As such, the importance of GP awareness about nursing roles in OAC care highlighted that ineffectual role clarity between GPs and nurses is a barrier to effective collaboration (White *et al*. 2008). As highlighted by others (Interprofessional Education Collaborative Expert Panel, 2011. P.20):

> "*Effective coordination and collaboration can occur only when each profession knows and uses the others' expertise and capabilities in a patient-centred way*."

Lack of coordination and collaboration can also lead to dissatisfaction within, and conflict between, clinicians and their roles (Almost *et al*. 2016). GPs held the advantage within general-practice power-based relationships here. Also, the nurses assumed correctly, that their roles were to be GP-assistants, and experienced conflicting expectations about their roles. According to scholars, the lack of clarity about the nurses' actual duties limits their roles within the team and the solution depends upon GPs actively seeking to understand nurses' scope of practice, to enable collaboration in OAC care (McInnes 2017).

However, both trust and respect are also important factors in enabling collaboration between clinician groups (Karam *et al*. 2018), and a key factor in developing and sustaining the OAC practice here. Furthermore, power and trust affect the choices made by the nurses in determining the need for, with whom and how, to build collaborative relationships in OAC care (Szafran *et al.* 2018). These were based upon three factors, 1) Trust and role perceptions, 2) Trust and competency demonstration, and 3) Reducing dependency on selected clinicians (McDonald *et al*. 2012; Szafran *et al.* 2018).

Firstly, the nurses were promised support to manage warfarin-dosing queries and required key clinical decisions to be made by the GPs, but this never materialized. In this instance, previously negotiated role-boundaries were not satisfied. This negatively affected the levels of nursing trust in GPs (McDonald *et al*. 2012) and led to nursing dissatisfaction in their OAC roles.

Secondly, the GPs had positioned themselves as the authority in making warfarin-dosing decisions within the POCT system using CDSS, an intervention that has been shown to be ineffective in improving OAC prescribing (Pritchett *et al*. 2019). They also promoted a desire for trust and respect, as a tool to encourage the nurses' willingness to cooperate initially with the OAC change (Szafran *et al.* 2018).

However, the GPs were also unable to satisfy the nurses' trust and respect, by a failure in being able to demonstrate competency (Pullin 2008; McDonald *et al*. 2012). For example, the nurses had requested GP-explanations and rationale for dosing instructions, for which the GPs always referred to the CDSS. This was an unsatisfactory response for the nurses' immediate clinical and learning needs, which demanded the nurses seeking to develop strategies to help them manage this clinical knowledge-gap in practice. Therefore, losing trust in the GPs' advice and methods for dealing with queries created mechanisms to circumvent routine practice and enabled new relationships of trust to become established, for the purposes of OAC care.

Thirdly, as experience grew in routine POCT, the nurses demonstrated a reduced dependency on GPs and a desire to minimize the impacts of OAC work on others. This developing autonomy was as seen in collaborative practice concerning diabetes in primary care, itself, empowering (McDonald *et al*. 2012) and has been previously considered to be a

facet of positive collaborative working (Maisey *et al.* 2008; Cousins & Donnell 2012; Hegney *et al.* 2013; McInnes *et al*. 2017). However, it was also disempowering for the GPs, who later lacked knowledge of the scope of nursing activity, including nursing-leadership in OAC practice.

General-practices may differ in underlying philosophies but are generally led by medically qualified GP partners who hold and assume overall authority (Huby *et al*. 2003; Szafran *et al.* 2018). However, leadership is an important factor for increasing the effectiveness of collaborations between clinician groups (Xyrichis *et al*. 2008). Leadership was demonstrated at different times during the NPT assessment here by different staff members depending upon the stages of OAC change. Subsequently, leadership factors were also identified as important drivers that should be considered in any future OAC/AF intervention involving integrated models of care in general-practice (Figure 56).

Team processes are also important factors in collaborative working. These include regular team meetings and enhanced communication amongst team members, which also assist in resolving interprofessional conflict, and promote positive, interpersonal relations (Xyrichis *et al*. 2008). However, in models of family practice which are owned and run as small businesses by GPs (including the focus practice in this thesis), a dual hierarchy exists, consisting of separate clinical and operational systems, where power sharing of clinical matters is compromised by GP-ownership (Russell *et al*. 2018). This was demonstrated in GAPS-2, where formal team meetings were viewed as instrumental devices to instruct nurses about new roles, rather than vehicles for discussion or debate, and represented a form of competitive or dominative power (Nugus *et al*. 2010). According to Szafran, *et al.* (2018), a general-practice culture of power and control is the result of a physician-model of teamworking promoted via medical training, involving no formal interprofessional training and which is a relational barrier to team-working in general-practice.

Alternatively, it was the informal meetings that staff held between themselves that were more productive in promoting and sustaining knowledge about OAC changes. This has been described as the production of clinician "*mindlines*", formed by sharing and trusting particular practices (Gabbay & LeMay 2011). These involved discussions about clinical episodes, decision-making and reflexivity, concerning clinical performance, which has been coined "*collaborative power*" (Nugus *et al*. 2010). The most common form of this, in

general-practice, has been described as ad-hoc communication, involving door-step meetings, or in-practice screen text messages (McInnes *et al*. 2017).

General practices define themselves relative to general medicine involving holistic care, public health, business and accountability of quality of care (Huby *et al*. 2008). These four factors are important in assessing the effects of implementing new services, such as those based on the QOF (Huby *et al*. 2008). Funding models for primary-care have also been implicated in relation to collaborative practice. For example, a review of contextual factors influencing the successful implementation of teamwork within family practices found that practices exclusively reimbursed by fee-for-service payments produced less collaborative care and more inter-professional isolation (Russell *et al*. 2018). This also has connotations for how practices face achieving maximum remuneration via changes in the general-practice contract, which have seen the introduction of QOF measures, and focused incentivized general-practice work, since 2003 (NHS Employers 2003).

The changes to QOF-AF acted as a positive mechanism for OAC change in this general-practice, by prompting the GPs' recognition of a need to act and is likened to the experience of changes around dementia. Here, also, a historic under diagnosis and a lack of GP-awareness (National Audit Office 2007) promoted changes around dementia general-practice (Department of Health 2009), including new enhanced services for GPs (NHS Commissioning Board 2013) like the OAC LES. Spillover effects, of enhanced dementia care, have also been found to be attributable to increased resources, from participation funding and better organizational skills (Liu *et al*. 2019). Similar unintended practice benefits were also found in this thesis. Positive general practice consequences included increased AF case-finding due to the raised AF awareness of staff. Furthermore, the increased OAC initiation facilitated by the confidence of OAC LES practice experience, and like elsewhere, the development of OAC management-systems (Huby *et al*. 2008). Finally, each factor also helped to shape the shared values between staff.

Shared-values between GPs and nurses do exist in primary care settings. These pertain to a commitment to provide ongoing, and increasing, quality of care (Pullon 2008). This was demonstrated in GAPS-2 by both the GPs seeking OAC change, and later, by the nurses who realized the improvements they had made in OAC care, in enacting OAC change. However, these shared-values much depend upon the organizational definitions that general-practices

place on themselves, in relation to QOF and new services (Huby *et al*. 2003). Furthermore, ongoing perceived barriers relating to specific role responsibility, time pressures and providing opportunistic preventative advice to patients, who are not unwell, continues to be a concern, in both AF discussions and other public health work (Keyworth *et al*. 2019).

Finally, it is also critical to include the patient role in considering the aspects of discussing risk and deciding OAC with AF patients (Jones 2014) and as part of any future integrated care model (Figure 56) and new clinical interventions designed to increase OAC uptake (Siontis *et al*. 2020). Repeatedly, AF patients when asked, underestimate their own stroke-risk, value preventing stroke more than risking major bleeding (Man-Son-Hing *et al* 1999, Zweiker *et al*. 2017), and would choose simpler drug regimens such as DOACs, if given the opportunity (Wilke *et al*. 2017). However, it has also been previously claimed, that only a quarter of AF patients are involved in decisions about OAC with DOACs (Choi *et al*. 2014). As there is now evidence for a clinician preference for DOACs over warfarin as first line OAC in AF patients (January *et al*. 2019), general-practice clinicians are perfectly placed to offer OAC shared decision-making to AF patients. Therefore, any new OAC intervention, must consider AF patients, particularly, the effects of patients (and specifically older patients), and their interactions with their clinicians during OAC/AF decision-making.

Patients' personal accounts were purposely not explored in this thesis, yet GAPS-1 and 2 findings suggested attitudes to ageing patients may have affected decisions to refer for or offer OAC. This is obviously important when taking into consideration the known increased prevalence of AF as patients age (Kirchhof *et al*. 2016). A "*conspiracy of silence*" has been levelled at GPs by older patients when including them in discussions about risk and treatments in other aspects of general-practice cardiovascular care (Van Bussel *et al*. 2019). This must be avoided and discussed as part of any future OAC/AF intervention, particularly as patients with AF may be more inclined to accept a lower stroke-risk as a threshold to commence OAC, compared to their GPs (Man-Son-Hing *et al*. 1999).

7.1 Limitations of this thesis.

Several limitations are noted in this thesis which arise from methodological choices and are considered against three key factors. These relate to the literature review methods, the case

study data collection methods specific to the use of a single practice case study and the omission of direct patient enquiry.

The first limitation concerning methods relates to my decision to omit RCTs from the literature review. Including RCTs may have exposed evidence relative to new OAC interventions in general-practice and how practices are organizing themselves around AF care.

Secondly, the utilization of the insider-researcher role may have created opportunities for bias (Reed & Procter 1995) caused through tacit knowledge of the case study's practices (Polanyi 1974).

Thirdly, I was an individual researcher undertaking a mixed methods case-study, who was also developing research skills. Consequently, there were limitations around aspects of data collection and analysis which required adequate skills and verification methods. Furthermore, limitations relative to time availability of being a full-time clinician/part-time researcher affected the planned schedules of the thesis (Andrew & Halcomb 2009). However, the development of research skills was aided by attending various short courses and seminars on specific aspects of the research process that were key to this thesis. Individual learning was experienced focusing upon various methods and aspects of digital data analysis techniques such as SPSS, and interview techniques.

The development of my research skills and implementation of such skills within the study context were thus aided and carefully supervised using researcher supervision and support. Furthermore, protected learning time provided by the research supervision team, also enabled me to access other resources such as statisticians who further enabled my skills development and also acted to clarify aspects mapping data and analysis.

Fourthly, the methods used in this thesis were used in a novel way on a subject with no precedent for comparison. As such, the data collection tools in both GAPS-1 and GAPS-2 could have been piloted, defined and scrutinized better, perhaps in another setting, prior to their use in this thesis (LoBiondo-Wood and Haber 2002).

Fifthly, critical appraisal of raw data into realist mechanisms was not straightforward, as found elsewhere (Hewitt *et al*. 2014). For example, when the GPs were discussing their reliance upon and trust in nurses conducting adequate quality control in OAC management, did this represent an agency-mechanism ([belief] about whether the GP trusts the nurses' previous abilities in organizing and managing other near-patient systems), or a relational-

mechanism (the GP trusts the work that the nurses do enacting OAC management)? Therefore, creating specific types of mechanisms about complex-context related data, may oversimplify the nature of the reality and thus, any models of practice that are generated from them (Hewitt *et al*. 2014).

Next, there were several further specific methodological limitations in this thesis relative to the use of a single-setting case study. Primarily, this case-study neither represented a critical case from which to test an established theory or a unique case. Rather, it was considered to be a typical case (Yin 2009).

However, this thesis found several important factors which are necessary to understand for the development of new AF/OAC systems. These factors included the use of risk assessment tools, ECG access and clinician interpretation, processes for making OAC decisions, responses to the changes to QOF, OAC/AF service models, DOAC management, nursing OAC/AF knowledge, power with clinician group relationships, patients and OAC decision-making. The importance of these factors in organizing new and effective AF/OAC services in primary care all require verification in other settings, to establish this case study a typical case.

Finally, there are also methodological limitations relating to the lack of a direct assessment of patients in the AF/OAC processes here. There is only inferential evidence in GAPS-2 about how patients have shaped AF/OAC systems in this practice. As such, the proposed OAC intervention model is potentially flawed in other settings.

7.2 Implications for nursing research and practice.

Previously, general-practice OAC use was only estimated by levels of OAC prescriptions and GP attitudes towards prescribing warfarin. This thesis captured a large general-practice's experience of changing OAC and AF care and for the first time, highlighting the extent of the general-practice's AF/OAC involvement. This involvement included both historic and current OAC care, which could be replicated in other general-practice settings. Furthermore, these AF/OAC practices and research about such practices should also be encouraged by other nurses working in advanced roles within general practice.

Advanced-Nurse-Practitioners (ANPs) in the UK are defined by expectations that ANPs should be engaged in areas such as research, service development, and management of patient care, as part of the fundamental, four pillars of care (Royal College of Nursing 2018).

As such, the insider-researcher approach used in this thesis enabled a type of exploration into OAC within general-practice which was specifically nurse-led. The insider-researcher approach, which offered a different lens to other research methods and served two purposes, could be utilized by other nurses in general-practice. Initially, the use of the insider-researcher approach involved a pre-role adjustment, encouraged by all the peers within the workplace. Boundaries, role expectations, and concurrent working practices were all agreed before the research commenced. This then enabled a focused and detailed examination of OAC influences for change that concentrated attention on shared, conventional meanings of practice and culture, and which non-insider-researcher methods might misinterpret.

The novel application of both NPT and realist analysis, was also a practical means of providing a systematic approach for general-practice insider-researching into OAC care. NPT was a valuable framework with which to assess the stages of OAC practice change. Furthermore, realist analysis effectively provided the means to identify mechanisms affecting OAC change and could be utilized by other ANPs employed in general practice in other areas of research study.

This thesis started from a provision of OAC underuse, based upon a limited GP role in AF and OAC care, and developed through to active OAC initiation and ongoing in-house management. OAC change here was instigated by the GPs' needs for improvement in quality of warfarin management communication, desire for better warfarin quality of care for patients and the need to manage practice finances. However, these aims were reliant upon the wider health care team with reliance upon a nursing consensus. Thus, a significant level of OAC service change and provision involved nursing agency, which is undisclosed in the literature about general-practice OAC care in AF patients.

However, change of OAC practice for AF patients also occurred due to an array of contextual and mechanistic factors involving GPs, nurses and structure. These factors pertained to roles, knowledge and agency.

However, each of the factors were also shaped by the effects of power in relation to the historic primary care model of practice, associated roles and financial costs, which may be typical in other general-practices. Further research is suggested in this area to explore how

other general practices organizational systems and cultures affect nursing roles and the development of AF/OAC services.

Opportunities for sustaining financial security for general service provision, enabled by QOF and the availability of enhanced services, helped to drive OAC changes for AF patients. However, the same motivations equally threatened sustaining OAC practice. Firstly, the eventual termination of OAC LES agreements and the emergence of new clinical priorities, primed by new financial opportunity, will change GP attitudes away from OAC in AF patients.

Secondly, OAC use is being rewarded in the current QOF-AF, in high-risk AF patients. However, ongoing DOAC quality management requires practice-based systems, most often led by nurses, which have no current financial provision and which will add burden to general-practice costs. Therefore, the demonstrated increased use of DOAC drugs that is superseding warfarin and becoming a normal aspect of general-practice work is without the financial underpinning. This ultimately threatens the support for its ongoing management currently experienced which will decrease the quality of OAC care, increase the likelihood of medication errors, and diminish the priority given to OAC use in AF patients by general practice. Other general practices will need to assess their approaches to DOAC management in relation to these circumstances. Reassessing DOAC management will also provide the opportunity for further research for and by ANPs who may be engaged in and/or are developing responsibilities for AF/OAC care.

OAC change for AF patients is not only possible but required in general practice. However, it is also restricted by the historic alignments to power, roles and adequate funding. General practices need to consider all factors in context, within all aspects and stages of implementing OAC change. This should include wherever possible, nurses and administrative staff in decisions and discussions about OAC change (Figure 56). Nurses also need to be encouraged to ascertain positions that can exert similar power to their GP colleagues. This could be achieved via new general practice models or encouraging nurse-GP partnerships.

The current QOF reflects the importance of AF as a risk factor for stroke. The predictions of increasing AF prevalence and the need to use of OAC in stroke-prevention means that all types of clinicians should be encouraged to take an active role within AF care, in general-practice. All general-practices operating under the current QOF will have already identified

their AF populations and should have assessed the current stroke-risk within those populations with a view to targeting patients at high stroke-risk with OAC. However, individual general practices will differ in their approaches to meeting the QOF requirements and it is unknown as to how many, or by what methods, this occurs routinely in the UK. This acknowledgment provides the opportunity for further nurse-led research in general practice in the UK.

Based upon the experiences in this case-study, a multi-skilled practice approach would be required to meet the demand for an AF/OAC service as a new intervention in general-practice (Figure 56). Organizing and managing patient recall systems requires vigilance and commitment which may be best implemented by non-clinical staff. As some practices will not undertake near-patient testing of warfarin, this is more likely to involve developing systems around the use of DOACs, which still require regular assessments and patient monitoring.

At present, guidelines, policies and procedures are only just emerging nationally for DOAC specific OAC care. Therefore, there is another opportunity for further research that would investigate how these guidelines are being shaped into systems locally in GP practices particularly as there are suggestions that GPs are already not adhering to recommended management guidelines (Murphy *et al*. 2020). DOAC care roles could be done by any staff that are suitability trained to assess ongoing stroke and bleeding-risk, factors affecting patient compliance and screening for potential OAC complications. Consequently, there is also a need to develop OAC consultations incorporating interval venous sampling and biochemical interpretation. This is fundamental to achieving the quality of care required to deliver a safe OAC service for patients and creates clinical capacity elsewhere.

The burden of increasing DOAC use on clinical capacity could be improved by increasing the use of non-medical prescribing. Therefore, there is also a requirement for staff with independent prescribing roles to enable the undertaking of treatment decisions, themselves based upon the collated clinical and non-clinical information gathered. Treatment decisions themselves may be monitored by nurses who do not have independent prescribing roles but ultimately, clinicians who prescribe need to have a lead clinical role in managing the AF caseload. As Figure 56. depicts, this could be a role for any clinician with independent prescribing status but with a commitment to improving OAC care.

There are also implications for general practice, particularly around the need for, and methods required, to develop future OAC/AF interventions for practice. Firstly, in general-practices that remain historically dependent upon specialists for directions about OAC decisions, there are opportunities for both GPs and nurses to play key roles in stroke-risk-reduction, and to make improvements in the quality of OAC care that has previously been afforded to AF patients.

Secondly, nurses in general practice are perfectly situated to develop levels of expertise in OAC care which could significantly impact upon the levels of stroke caused by AF. A greater nursing-awareness of the association between AF and preventable stroke-risk with OAC could empower nurses into becoming more proactive about entering new roles which incorporate OAC practice.

Thirdly, patients who experience two levels of service provision, also experience reduced levels of quality of care that can be improved by practice-based nursing leadership. Fourthly, there is a need to promote both patient AF awareness and encourage whenever possible, patient participation in decision-making about OAC treatments and onward managements. Patient involvement, either through understanding their experiences of OAC systems, and/or wishes around OAC therapy, will help to shape clinicians' perspectives about future OAC interventions in general practice.

Finally, as DOAC drugs become first-line choice for stroke prevention in AF patients, general-practice needs to have adequate management structures available to maintain patients' safety and ensure the quality of patient OAC care. This will require a multidisciplinary approach.

7.3 Recommendations/directions for future research.

The CMOs that emerged in this thesis are unique to this general practice. But some CMOs may be experienced in other such settings, and this requires further research. Thus, there are several recommendations for further research which have emerged from the findings and limitations of this thesis and are required for a future OAC/AF integrated care intervention in general practice, as suggested in Figure 56 (P.243).

Firstly, further research is suggested in relation to the research methods limitations already described. These limitations included a need to expand insider-researcher led AF/OAC

studies from other typical and atypical settings in primary care, combining multiple settings and multiple researcher collaboration.

Secondly, a systematic review is proposed to investigate AF/OAC interventions in general-practice settings which might further enhance knowledge about current AF/OAC use and models of care in general-practice overlooked in this thesis.

Thirdly, further research is required that expands AF/OAC enquiry into broader general practice, building upon the CMO findings from this case study. Specifically, there are several key questions that require further enquiry by way of a national general-practice survey and/or specific focus groups, which encompass aspects of organizational and relational factors. These enquiries should explore how other general practices are responding to QOF changes and organizing their routine practices to incorporate the increasing provision of DOAC drugs. Consequently, there is also a need to expand knowledge about other general-practices clinicians' attitudes towards DOAC use, whilst also mapping other models of general-practice OAC management.

In relation to clinician OAC use, further research is required to establish the wider experiences of clinicians' access to, and interpretation of, ECGs. Furthermore, there is also a need to research the wider general-practice contexts' reliance or otherwise, upon specialists for OAC decisions, and understand to what extent shared decision-making with patients occurs for OAC.

Secondly, there is a need to test if OAC tools are used routinely and discern what methods are being employed to manage the outcomes of such assessments across the UK general-practice landscape. For example, the CHA_2DS_2-VASC score is an easy auto-computed calculation, where clinicians can simply click a visual prompt if they choose to do so. Whereas, there are no such automated bleeding-risk tools on EMIS (the system for records used in this case-study). Thus, estimating bleeding risk takes more time, effort and knowledge about bleeding risk-factors for the clinician to estimate and record in the patient record. These extra measures may prevent the use of bleeding-risk assessments thus clinician engagement in OAC decision making in general practice.

The current dearth of available research relating to nursing AF/OAC practices also needs to be addressed, be encouraged and expanded. Therefore, further exploration of nursing roles, knowledge, and attitudes around AF/OAC also requires examination in other general-practice settings. This is because developing OAC systems requires a multi-role approach

(Figure 55) and GPs will continue to delegate roles and rely upon the skills of their practice teams. These delegated roles will include nurses, who are expected to manage OAC medications and for which, there is a lack of evidence examining the methods that they currently use, how nurses are involved in new service planning and how OAC roles are developed in general practice.

Furthermore, there is also a gap in the research about nurses who hold non-medical independent-prescribing responsibilities. Further research is required specifically in relation to NMP's roles and extent in OAC prescribing in general practice. This is particularly important given the emergence and preferred use of DOAC drugs, which also brings new challenges to general practice. Lastly, in relation to nursing, a broader approach to examining power within relationships between nurses and their GP employers is also necessary to challenge the findings in this thesis.

Finally, there is a requirement to understand the patient perspective in relation to their general-practice experiences of AF/OAC care. This includes how they perceive their role, if any, in OAC decision-making in conjunction with general-practice clinicians. Lastly, in relation to patient use of OAC, persistence of general-practice managed OAC was not included in this thesis. Therefore, also there needs to be a broad examination of how patients perceive access to a range of different general-practice OAC services, experience specific barriers and facilitators to care, and analyse how these factors may affect OAC persistence, specific to general-practice managed OAC.

The culmination of the findings from this thesis and the findings from the proposed research areas will then require translation into improved practice, via the development, implementation and evaluation of suitable interventions and/or practice changes.

In conclusion, this thesis proposes that general practice is centrally important to the detection of AF and the promotion of OAC for stroke prevention. Furthermore, an integrated care-team approach, underpinned by a determination to improve standards of AF/OAC care and patient safety, can be achieved. Thereby, increasing the rates of OAC use in general practice. However, further research is required to explore factors that are essential to a future AF/OAC intervention. These research proposals include the variations of AF/OAC integrated care models in general-practice, nursing knowledge and attitudes to AF/OAC care and patients' roles within OAC decision-making and within the construction of integrated care models and the role of patients in general practice OAC use.

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Appendices.

Appendix 1. Key changes affecting primary care AF and OAC management.

Year.	Reference.	Key quoted points.
1991	Stroke Prevention in AF investigators.	•Excluding patients aged greater than 75 years, antithrombotic therapy with aspirin or warfarin is indicated for most atrial fibrillation patients who can safely take these medications.
1992	Laupacis.	•Evidence relates to 4 RCTs only with highly selective patients comparing VKA to aspirin. VKA more effective. •Conditions for management should reflect those of the trails. •Both had positive effects at reducing stroke in NVAF with bleeding-risk associated. • OAC decisions should be based on clinical judgment considering patients' individual preferences and risk-factors for bleeding.
1994	Anon.	• Warfarin consistently decreased the risk of stroke in patients with atrial fibrillation (a 68% reduction in risk) with virtually no increase in the frequency of major bleeding. •Aspirin should be first choice for patients aged under 75 and at lower risk of stroke.
1994	Atrial Fibrillation Investigators.	•In these five randomized trials warfarin consistently decreased the risk of stroke in patients with atrial fibrillation (a 68% reduction in risk) with virtually no increase in the frequency of major bleeding. •Patients with atrial fibrillation younger than 65 years without a history of hypertension, previous stroke or transient ischemic attack, or diabetes were at very low-risk of stroke even when not treated. •The efficacy of aspirin was less consistent. Further studies are needed to clarify the role of aspirin in atrial fibrillation.
1994	Matchar.	•Warfarin is strongly recommended for persons with nonvalvular AF who are older than 60 years or who have additional risk-factors for stroke. •Aspirin is recommended for persons at elevated risk for bleeding while receiving anticoagulants. •For persons with TIA or minor stroke, aspirin should be used first.
1994	Stroke. Prevention in Atrial Fibrillation Investigators.	• Warfarin may be more effective than aspirin for prevention of ischaemic stroke in patients with atrial fibrillation, but the absolute reduction in stroke rate by warfarin is small. •Younger patients without risk-factors had a low rate of stroke when treated with aspirin. •In older patients the rate of stroke (ischaemic and haemorrhagic) was substantial, irrespective of which agent was given.

		•Patient age and the inherent risk of thromboembolism should be considered in the choice of antithrombotic prophylaxis for patients with atrial fibrillation.
1998	British Committee for Standards in Haematology.	•Warfarin should be considered as first-line therapy for patients with AF and at least one risk-factor (previous thromboembolism, hypertension, heart failure, abnormal left ventricular function on echocardiogram) for thromboembolism. • Patients should be reviewed as the benefits / risk ratio may alter with increasing age of development of additional illness. (*age reported to increase bleeding-risk*)
2001	Albers.	•For patients with any high-risk factor or more than one moderate-risk factor, we recommend warfarin (target INR 2.5; range, 2.0 to 3.0). •The ultimate choice of therapy depends on many factors, including the clinician's assessment of the magnitude of the patient's risk (e.g. whether the patient has single or multiple risk-factors), the ability to provide high-quality monitoring of the intensity of OAC, the patient's risk of bleeding with OAC, and patient preference. **Stroke-risk factors described as**: •*High-risk*; factors include prior stroke/TIA or systemic embolus, history of hypertension, poor LV systolic function, age > 75 years, rheumatic mitral valve disease, and prosthetic heart valve. •*Moderate risk*; factors (factors for stroke that have been identified in AF patients in various studies but are not as strong or consistent as the high-risk factors listed above) include age 65 to 75 years, diabetes mellitus, and coronary artery disease with preserved LV systolic function. **Risk-category Recommended Therapy:** •*High-Risk Patients.* Use of adjusted-dose warfarin OAC (target INR 2.5; range 2.0 to 3.0) rather than aspirin. For high-risk patients, clinicians should offer aspirin therapy if adjusted-dose warfarin Is contraindicated or declined by the patient and if there are no contraindications to aspirin. Do not use aspirin plus low-fixed-dose warfarin therapy. •*Moderate-Risk*: Use of either OAC or aspirin for patients with one of these moderate risk-factors. Patients with more than one of these moderate-risk factors are at higher risk of stroke than are those with only one risk-factor, treat these patients in the same manner as high-risk patients. •*Low-Risk patients:* Patients with AF who are <65 years with no clinical or echocardiographic evidence of cardiovascular disease should be treated with aspirin.
2001	Fuster.	•Age less than 60 years No heart disease (lone AF) Aspirin (325 mg daily) or no therapy. •Age less than 60 years Heart disease but no risk-factors* Aspirin (325 mg daily). •Age greater than or equal to 60 years No risk-factors* Aspirin (325 mg daily).

		•Age greater than or equal to 60 years with diabetes mellitus or CAD Oral OAC (INR 2.0–3.0). Addition of aspirin, 81–162 mg daily is optional. •Age greater than or equal to 75 years especially women Oral OAC (INR 2.0). •HF LV ejection fraction less than or equal to 0.35 Thyrotoxicosis Hypertension Oral OAC (INR 2.0–3.0). •Risk-factors for thromboembolism include HF, LV ejection fraction less than 0.35, and history of hypertension.
2001	Gage.	$CHADS_2$ risk-scoring.
2004	Leys.	Requested.
2004	Singer.	**Stroke-risk factors described as**: •*High-risk*; factors include prior stroke/TIA or systemic embolus, history of hypertension, Diabetes, moderate – severe impaired LV systolic function or congestive cardiac failure, age > 75 years, rheumatic mitral valve disease. •*Intermediate-risk*; factors in persistent of paroxysmal AF, age 65-75 years, in the absence of other risk factors. •*Low-risk:* Patients below 65 years with no other risk-factors. **Risk-category Recommended Therapy:** •*High-Risk Patients.* Use of adjusted-dose warfarin OAC (target INR 2.5; range 2.0 to 3.0). •*Intermediate-risk*: Use of *either* OAC or aspirin 325mg/d for patients with one of these moderate risk-factors. Patients with more than one of these moderate-risk factors are at higher risk of stroke than are those with only one risk-factor, treat these patients in the same manner as high-risk patients. •*Low-Risk patients:* Patients with AF who are <65 years with no clinical or echocardiographic evidence of cardiovascular disease should be treated with aspirin 325mg/d.
2004	Van Lieshout.	•Level of stroke-risk should determine choice of antithrombin with lower risk treated with APL. •Low-risk is patients under 65 with no additional risk-factors (Diabetes, hypertension, CVA/TIA, coronary artery disease, heart failure). • Patients at increased risk should be weighed against bleeding-risk and treated with OAC. •Patients with atrial fibrillation and heart failure get OAC.
2006	British Medical Association and NHS Employers.	**Records:** •*AF 1*: The practice can produce a register of patients with atrial fibrillation. **Initial diagnosis:** •*AF 2:* The percentage of patients with atrial fibrillation 40–90% diagnosed after 1 April 2006 with ECG or specialist confirmed diagnosis. **On-going management:**

		•*AF 3*: The percentage of patients with atrial fibrillation 40–90% who are currently treated with anti-coagulation drug therapy or an anti-platelet therapy.
2006	Fuster.	**•Use of the risk-category CHADS$_2$ risk-score •No reference to bleeding-risk assessment.** **Stroke-risk factors described as**: •*Less Validated or Weaker Risk-factors*: Female gender, Age 65 to 74 y Coronary artery disease Thyrotoxicosis. •*Moderate-Risk Factors:* Age greater than or equal to 75 y Hypertension Heart failure LV ejection fraction 35% Diabetes mellitus. •*High-Risk Factors*: Previous stroke, TIA or embolism Mitral stenosis Prosthetic heart valve. **Risk-category Recommended Therapy:** •*No risk-factors* = Aspirin, 81 to 325 mg daily. •*One moderate-risk factor* = Aspirin, 81 to 325 mg daily, or warfarin (INR 2.0 to 3.0, target 2.5). •*Any high-risk factor or more than 1 moderate-risk factor* = Warfarin (INR 2.0 to 3.0, target 2.5).
2006	Goldstein.	**•Use of the risk-category CHADS$_2$ risk-score •No reference to bleeding-risk assessment.** •Consider patient preferences, bleeding-risk, and access to good INR monitoring. **Stroke-risk factors described as:** •*Low-risk*: CHADS$_2$ risk-score = 0. •*Intermediate-risk:* CHADS$_2$ risk-score = 1. •*High-risk:* CHADS$_2$ risk-score = >2. **Risk-category Recommended Therapy:** •*High-risk:* Treat with Warfarin INR 2–3. •*Moderate risk*: Treat with Warfarin INR 2–3 or aspirin (75–325 mg/d). •*Low-risk:* Treat with Aspirin 75 to 325 mg/day if no CIS.
2006	National Institute for Health and Clinical Excellence.	•For all clinicians - In patients with newly diagnosed AF for whom antithrombotic therapy is indicated such treatment should be initiated with minimal delay after the appropriate management of comorbidities. Patients with paroxysmal, persistent, permanent AF to have a stroke-risk assessment. **Stroke-risk factors described as:** •*High-risk:* • Previous ischaemic stroke/TIA or thromboembolic event • age ≥75 with hypertension, diabetes or vascular disease • clinical evidence of valve disease or heart failure, or impaired left ventricular function on echocardiography. •*Moderate risk*: • Age ≥65 with no high-risk factors • age <75 with hypertension, diabetes or vascular disease.

		Low-risk: • Age <65 with no moderate or high-risk factors. **Risk-category Recommended Therapy:** •*High-risk:* Treat with OAC with Warfarin. •*Moderate risk*: Treat with Consider OAC or aspirin. •*Low-risk:* Treat with Aspirin 75 to 300 mg/day if no CIS.
2010	Camm.	**•Use of the risk-category CHA_2DS_2VASC risk-score. *Use the HASBLED bleeding-risk score.** •Recommended antithrombotic therapy. •*High-risk:* One 'major' risk-factor or >2 'clinically relevant non-major' risk-factors use OAC. •*Intermediate-risk:* One 'clinically relevant non-major' risk-factor, use either, OAC or aspirin 75–325 mg daily. (Preferred: OAC rather than aspirin.) •*Low-risk:* No risk-factors 0 Either aspirin 75– 325 mg daily or no antithrombotic therapy. (Preferred: no antithrombotic therapy rather than aspirin.)
2010	Lip.	CHA_2DS_2VASC risk-score.
2011	Cairns.	**•Use of the risk-category $CHADS_2$ risk-score. •Use the HASBLED bleeding-risk score.** **Stroke-risk factors described as:** •*Low-risk*: $CHADS_2$ risk-score = 0. •*Intermediate-risk:* $CHADS_2$ risk-score = 1. •*High-risk:* $CHADS_2$ risk-score = >2. •All patients with AF or AFL (paroxysmal, persistent, or permanent) should be stratified using a predictive index for stroke (e.g. $CHADS_2$) and for the risk of bleeding (e.g. HASBLED) and that most patients should receive antithrombotic therapy. **Risk-category Recommended Therapy:** •*High-risk:* Treat with OAC most patients should receive Dabigatran in preference to warfarin. •*Moderate-risk*: Treat with warfarin [INR 2 to 3] or Dabigatran. •*Low-risk:* Treat with Aspirin 75 to 325 mg/day if no CIS.
2012	Camm.	**•Use of the risk-category CHA_2DS_2VASC risk-score. *Use the HASBLED bleeding-risk score.** •NOAC preferred as first line anticoagulant. **Stroke-risk factors described as:** •*High-risk:* CHA_2DS_2VASC risk-score > 2. •*intermediate-risk*: CHA_2DS_2VASC risk-score =1. •*Low-risk*: CHA_2DS_2VASC risk-score =0. (<65 years and lone AF (including females). **Risk-Category Recommended Therapy:**

		•*High-risk:* Assess bleeding-risk (HASBLED score) = Oral anticoagulant therapy/Consider patient values and preferences (NOAC or VKA). •*intermediate-risk:* Assess bleeding-risk (HASBLED score) = Oral anticoagulant therapy / Consider patient values and preferences (NOAC or VKA). •*Low-risk:* No antithrombotic.
2012	Guyatt.	**Stroke-risk factors described as:** •*Low-risk*: $CHADS_2$ risk-score = 0. •*Intermediate-risk:* $CHADS_2$ risk-score = 1. •*High-risk:* $CHADS_2$ risk-score = >2. **Risk-category Recommended Therapy:** •*Low-risk*: No therapy rather than antithrombotic therapy. For patients who do choose antithrombotic therapy, we suggest aspirin (75 mg to 325 mg once daily) rather than oral OAC or combination therapy with aspirin and clopidogrel. For patients who are unsuitable for or choose not to take an oral anticoagulant (for reasons other than concerns about major bleeding), we suggest combination therapy with aspirin and clopidogrel rather than aspirin (75 mg to 325 mg once daily). •*Intermediate-risk:* Oral OAC rather than no therapy. We suggest oral OAC rather than aspirin (75 mg to 325 mg once daily) or combination therapy with aspirin and clopidogrel. For patients who are unsuitable for or choose not to take an oral anticoagulant (for reasons other than concerns about major bleeding), we suggest combination therapy with aspirin and clopidogrel rather than aspirin (75 mg to 325 mg once daily). •*High-risk:* Oral OAC rather than no therapy, aspirin (75 mg to 325 mg once daily), or combination therapy with aspirin and clopidogrel (Grade 1B). For patients who are unsuitable for or choose not to take an oral anticoagulant (for reasons other than concerns about major bleeding), we recommend combination therapy with aspirin and clopidogrel rather than aspirin (75 mg to 325 mg once daily). •For patients with AF, including those with paroxysmal AF, for recommendations in favour of oral OAC we suggest Dabigatran 150 mg twice daily rather than adjusted-dose VKA therapy (target INR range, 2.0-3.0).
2012	National Institute for Health and clinical excellence.	•adds Dabigatran to choose of OAC.
2012	Scott.	**•Use of the risk-category CHA_2DS_2VASC risk-score. •Use the HASBLED bleeding-risk score.** **Stroke-risk factors described as:**

		•*High-risk:* CHA_2DS_2VASC risk-score > 2. •*intermediate-risk:* CHA_2DS_2VASC risk-score =1. •*Low-risk:* CHA_2DS_2VASC risk-score =0. (<65 years and lone AF (including females). **Risk-category Recommended Therapy:** • Patients with paroxysmal, persistent or permanent AF who are over the age of 65 or who have any risk-factor for stroke should be considered for OAC. •*Low-risk:* No antithrombotic therapy. •Aspirin should not be used for stroke prevention in AF as it is ineffective; patients who are taking aspirin solely for this purpose should be reviewed. •The combination of aspirin plus clopidogrel reduces ischaemic stroke-risk in AF but this is offset by a risk of serious bleeding. Therefore, this combination is not recommended for thromboprophylaxis in AF. •Before starting an OAC it is important to assess the risks and benefits of treatment, including an assessment of cognition and comorbidities. Use of the HASBLED tool can help identify modifiable bleeding-risks which need to be addressed but should not on its own be used to exclude patients from OAC therapy. • OAC should be with either well-controlled warfarin (currently standard treatment) or one of the new OACs. •Newer OACs (direct thrombin and factor Xa inhibitors) are an option for patients who cannot tolerate, have an allergy to, or who cannot achieve satisfactory anticoagulant control on warfarin. •All patients with AF should have the risks and benefits of OAC assessed annually. •All providers of OAC services should provide annual data of TTR (time in therapeutic range) as a means of quality improvement. •Anticoagulant control may be improved by near patient testing and engaging patients in their own care; patient education should be supported at every stage.
2012	Skanes.	**•Use of the risk-category $CHADS_2$ risk-score •Use the HASBLED bleeding-risk score.** **Stroke-risk factors described as:** •*High-risk:* $CHADS_2$ risk-score > 2. •*intermediate-risk*: $CHADS_2$ risk-score =1. •*Low-risk:* $CHADS_2$ risk-score =0. **Risk-Category Recommended Therapy:** when OAC therapy is indicated, most patients should receive Dabigatran, Rivaroxaban, or Apixaban (once approved by Health Canada), in preference to warfarin. •*High-risk:* Should receive OAC therapy. •*Intermediate-risk*: Most patients at intermediate-risk of stroke should receive OAC. Based on individual risk/benefit considerations, that ASA is a reasonable alternative for some (Conditional Recommendation).

		• *Low-risk:* Patients at low-risk of stroke ($CHADS_2$ risk-score = 0) should have additional risk-factors for stroke considered (including age 65-74 years, female sex, and presence of vascular disease). Suggest OAC therapy for patients at highest risk within this category (age greater than age 65 or the combination of female sex and vascular disease); ASA (75-325 mg/day) for patients at lower risk within this category (female sex or vascular disease); and no antithrombotic therapy for those patients at lowest risk in this category (no additional risk-factors).
2012	You.	**Stroke-risk factors described as:** •*High-risk:* $CHADS_2$ risk-score = > 2. •*intermediate-risk:* $CHADS_2$ risk-score =1. •*Low-risk:* $CHADS_2$ risk-score = 0. **Risk-Category Recommended Therapy:** •*High-risk:* Oral OAC rather than no therapy, aspirin, or combination therapy with aspirin and clopidogrel. Dabigatran is the favoured oral OAC. •*Intermediate-risk*: Oral OAC rather than no therapy and suggest oral OAC rather than aspirin or combination therapy with aspirin and clopidogrel. • *Low-risk:* No therapy rather than antithrombotic therapy.
2013	British Medical Association and NHS Employers.	**Records** •AF1. The practice can produce a register of patients with atrial fibrillation. **Initial diagnosis:** •AF5. The percentage of patients with atrial fibrillation in whom stroke-risk has been assessed using the $CHADS_2$ risk-stratification scoring system in the preceding 15 months (excluding those who's previous $CHADS_2$ risk-score is greater than 1). **Ongoing management:** •AF6. In those patients with atrial fibrillation in whom there is a record of a $CHADS_2$ risk-score of 1 (latest in the preceding 15 months), the percentage of patients who are currently treated with anti-coagulation drug therapy or anti-platelet therapy. •AF7. In those patients with atrial fibrillation whose latest record of a $CHADS_2$ risk-score is greater than 1, the percentage of patients who are currently treated with anti-coagulation therapy.
2013	Heidbuchel.	Building upon Camm, *et al.* (2012). **Initiator of OAC therapy:** •Sets indication for OAC. •Makes choice of OAC.

		•Decides on need for proton pump inhibitor. •Baseline haemoglobin, renal and liver function. •Provides education. •Hands out OAC card. •Organised follow up (when, by whom, what?). •Remains responsible co-ordinator for follow up. **First FU: 1 month:** •Follow up: GP, OAC clinic, initiator of therapy, etc. *Checks:* •Compliance (patient should bring remaining pills). •Thrombo-embolic events. •Bleeding events. •Other side-effects. •Co-medications and over –the-counter medications. •Need for bloods sampling? (1m?, 3M?, 6m?). In case of problems: contacts initiator of treatment. Or Fills out OAC care and sets date for next follow up.
2014	January.	• **Use of the risk-category CHA_2DS_2VASC risk-score. *Use the HASBLED bleeding-risk score.** •Antithrombotic therapy based on shared decision-making, discussion of risks of stroke and bleeding, and patient's preferences. •Selection of antithrombotic therapy based on risk of thromboembolism. • CHA_2DS_2VASC risk-score recommended to assess stroke-risk. •With prior stroke, TIA, or CHA_2DS_2VASC risk-score ≥2, oral anticoagulants recommended. Options include: Warfarin, Dabigatran, Rivaroxaban, or Apixaban. •Re-evaluate the need for OAC at periodic intervals. •With nonvalvular AF and CHA_2DS_2VASC risk-score of 0, it is reasonable to omit antithrombotic therapy.
2014	Kildea-Shine and O'Riordan (2014).	The Medicines Management Programme in conjunction with the PCRS issued a circular in January 2014 stating that "warfarin is the oral anticoagulant of choice" and that NOACs should be reserved for: • Patients who have a documented allergy to warfarin. • Patients already on warfarin who have poorly controlled INR despite adhering to monitoring and lifestyle requirements to optimise warfarin therapy.

		• Patients who require regular periodic treatment with medications that interact with warfarin.
2014	NICE.	**• Use of the risk-category CHA_2DS_2VASC risk-score. *Use the HASBLED bleeding-risk score.** • Use the CHA_2DS_2VASC stroke-risk score to assess stroke-risk in people with any of the following: symptomatic or asymptomatic paroxysmal, persistent or permanent atrial fibrillation, Atrial flutter. •For most people the benefit of OAC outweighs the bleeding-risk for people with an increased risk of bleeding the benefit of OAC may not always outweigh the bleeding-risk, and careful monitoring of bleeding-risk is important. • Do not withhold OAC solely because the person is at risk of having a fall. • Do not offer stroke prevention therapy to people aged less than 65 years with atrial fibrillation and no risk-factors other than their sex (that is, very low-risk of stroke equating to a CHA_2DS_2VASC risk-score of 0 for men or 1 for women). **OAC:** • OAC may be with Apixaban, Dabigatran etexilate, Rivaroxaban or a vitamin K antagonist. •Consider OAC for men with a CHA_2DS_2VASC risk-score of 1. Take the bleeding-risk into account. •Offer OAC to people with a CHA_2DS_2VASC risk-score of 2 or above, taking bleeding-risk into account. •Discuss the options for OAC with the person and base the choice on their clinical features and preferences.
2015	British Medical Association and NHS Employers	**Records:** •AF001. The contractor establishes and maintains a register of patients with atrial fibrillation. **Ongoing management:** •AF006. The percentage of patients with atrial fibrillation in whom stroke-risk has been assessed using the CHA_2DS_2VASC risk-score risk stratification scoring system in the preceding 12 months (excluding those patients with a previous $CHADS_2$ or CHA_2DS_2VASC risk-score of 2 or more). •AF007. In those patients with atrial fibrillation with a record of a CHA_2DS_2VASC risk-score of 2 or more, the percentage of patients who are currently treated with anti-coagulation drug therapy.
2016	Hobbs.	**• Use of the risk-category CHA_2DS_2VASC risk-score. •Use the HASBLED bleeding-risk score.** •CHA_2DS_2VASC risk risk-score is superior to $CHADS_2$ risk-score for assessing stroke-risk in AF and should specifically be used to identify who should not receive OAC. • Alternatively, since $CHADS_2$ is simpler to use, patients' risk of stroke can be initially assessed using $CHADS_2$ but if their score is 1 or less, then a CHA_2DS_2VASC risk-score should be performed to identify those patients who do not require OAC. • As a second step, HASBLED-score should be used to assess bleeding-risk, with the aim of modifying this risk through addressing individual risk-factors that can be altered.

		Stroke-risk factors described as: •*High-risk:* CHA_2DS_2VASC risk-score = > 2. •*intermediate-risk:* CHA_2DS_2VASC risk-score =1. •*Low-risk:* CHA_2DS_2VASC risk-score = 0. (<65 years and lone AF (including females). **Risk-Category Recommended Therapy:** •*High-risk:* Patients with a CHA_2DS_2VASC risk-score of 2 or above should be offered OAC. •*Intermediate-risk*: In patients with a CHA_2DS_2VASC risk-score of 1, consider OAC and base any decision to treat or not treat on patient preference after balancing the benefits with risks of treatment. •Patients with a CHA_2DS_2VASC risk-score of 0 should not be offered antiplatelet or OAC therapy. **Managing decisions:** • HASBLED-score should not be used to decide whether to offer OAC in someone with a CHA_2DS_2VASC risk-score of 2 or above but consider its use to balance the benefits of OAC in patients with a CHA_2DS_2VASC risk-score of 1. • On a regular basis, presumed once a year, the risk status of patients with AF should be re-evaluated depending on change in risk-factors (change of age category, new hypertension, etc). • Only in those intolerant of, or refusing, OAC may a combination of anti-platelets be considered (though the bleeding-risk of this strategy will approach that of OAC). All AF patients at high-risk of stroke should be offered OAC. • NOACs represent more convenient, at least as safe, and at least equally effective option in the prevention of stroke in AF compared to VKAs, including in elderly patients. However, based on cost and access issues, NOACs and VKAs both represent good treatment options for SPAF. • Patients should be fully counselled, including written information, on the risks and benefits of OAC or on changing to or initiating a NOAC. • Patient preferences should guide decision-making over whether to initiate OAC, and on what to prescribe, including estimation of a patient's compliance.
2016	Kirchhoff.	**•Use of the risk-category CHA_2DS_2VASC risk-score. •Use the HASBLED bleeding-risk-score.** •Oral OAC therapy to prevent thromboembolism is recommended for all male AF patients with a CHA_2DS_2VASC risk-score of 2 or more. •Oral OAC therapy to prevent thromboembolism is recommended in all female AF patients with a CHA_2DS_2VASC risk-score of 3 or more. •Oral OAC therapy to prevent thromboembolism should be considered in male AF patients with a CHA_2DS_2VASC risk-score of 1, considering individual characteristics and patient preferences.

		•Oral OAC therapy to prevent thromboembolism should be considered in female AF patients with a CHA_2DS_2VASC risk-score of 2, considering individual characteristics and patient preferences. •When oral OAC is initiated in a patient with AF who is eligible for a NOAC (Apixaban, Dabigatran, edoxaban, or Rivaroxaban), a NOAC is recommended in preference to a vitamin K antagonist. •When patients are treated with a vitamin K antagonist, time in therapeutic range (TTR) should be kept as high as possible and closely monitored. •AF patients already on treatment with a vitamin K antagonist may be considered for DOAC treatment if TTR is not well controlled despite good adherence, or if patient preference without contra-indications to NOAC (e.g. prosthetic valve). •Combinations of oral anticoagulants and platelet inhibitors increase bleeding-risk and should be avoided in AF patients without another indication for platelet inhibition. •In male or female AF patients without additional stroke-risk factors, anticoagulant or antiplatelet therapy is not recommended for stroke-prevention. •Antiplatelet monotherapy is not recommended for stroke prevention in AF patients, regardless of stroke-risk.

Appendix 2: Example of search trail used

	MEDLINE	exp WARFARIN/	13864	Apply Limits
	2	MEDLINE	warfarin.ti,ab	14987
	3	MEDLINE	exp COUMARINS/	38775
	4	MEDLINE	coumarins.ti,ab	1994
	5	MEDLINE	exp ANTICOAGULANTS/	182322
	6	MEDLINE	ANTICOAGUL*.ti,ab	59551
	7	MEDLINE	coagulat*.ti,ab	73863
	8	MEDLINE	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7	277684
	9	MEDLINE	*STROKE/ OR *CEREBROVASCULAR DISORDERS/ OR *ISCHEMIC ATTACK, TRANSIENT/ OR *BRAIN ISCHEMIA/	100561
	10	MEDLINE	(stroke OR derebrovascular OR ischem*).ti,ab	321153
	11	MEDLINE	9 OR 10	346974
	12	MEDLINE	exp ATRIAL FIBRILLATION/ OR *ARRHYTHMIAS, CARDIAC/	63015
	13	MEDLINE	(atrial ADJ fibrillation OR ARRHYTHMIA).ti,ab	59165
	14	MEDLINE	12 OR 13	90201
	15	MEDLINE	exp GENERAL PRACTITIONERS/	1551
	16	MEDLINE	(physician OR doctor OR clinician OR practitioner).ti,ab	220150
	17	MEDLINE	15 OR 16	221259
	18	MEDLINE	8 AND 11 AND 14 AND 17	175

☐	19	CINAHL	exp WARFARIN/	3333
☐	20	CINAHL	warfarin.ti,ab	2564
☐	21	CINAHL	coumarins.ti,ab	74
☐	22	CINAHL	exp ANTICOAGULANTS/	12052
☐	23	CINAHL	(anticoag* OR coagulat*).ti,ab	7262
☐	24	CINAHL	19 OR 20 OR 21 OR 22 OR 23	16246
☐	25	CINAHL	exp STROKE/	28845
☐	26	CINAHL	(stroke OR derebrovascular OR ischem*).ti,ab	40872
☐	27	CINAHL	25 OR 26	49393
☐	28	CINAHL	exp PHYSICIANS, FAMILY/	7775
☐	29	CINAHL	(physician OR doctor OR cilInician OR practitioner).ti,ab	48104
☐	30	CINAHL	28 OR 29	54413
☐	31	CINAHL	24 AND 27 AND 30	75
☐	32	EMBASE	exp WARFARIN/	56670
☐	33	EMBASE	exp COUMARIN DERIVATIVE/	83413
☐	34	EMBASE	(warfarin OR coumarins OR anticoagul* OR coagulat*).ti,ab	169743
☐	35	EMBASE	exp ANTICOAGULANT AGENT/	444802
☐	36	EMBASE	32 OR 33 OR 34 OR 35	547244
☐	37	EMBASE	exp CEREBROVASCULAR ACCIDENT/	53074

☐	38	EMBASE	exp TRANSIENT ISCHEMIC ATTACK/	22760
☐	39	EMBASE	exp BRAIN ISCHEMIA/	93716
☐	40	EMBASE	(stroke OR derebrovascular OR ischem*).ti,ab	414097
☐	41	EMBASE	37 OR 38 OR 39 OR 40	457330
☐	42	EMBASE	*HEART ATRIUM FIBRILLATION/	35257
☐	43	EMBASE	*HEART ARRHYTHMIA/	38326
☐	44	EMBASE	(artrial ADJ fibrillation OR arrhythmia).ti,ab	35443
☐	45	EMBASE	42 OR 43 OR 44	95526
☐	46	EMBASE	exp GENERAL PRACTITIONER/	53693
☐	47	EMBASE	(physician OR doctor OR clinician OR practitioner).ti,ab	263757
☐	48	EMBASE	36 AND 41 AND 45 AND 47	225
☐	49	EMBASE	48 [Limit to: Human and English Language]	182
☐	50	HMIC, BNI, HEALTH BUSINESS ELITE	(warfarin OR coumarins OR anticoagul* OR coagul*).ti,ab	1702
☐	51	HMIC, BNI, HEALTH BUSINESS ELITE	(stroke OR cerbrovascular OR ischem OR derebrovascular).ti,ab	7738
☐	52	HMIC, BNI, HEALTH BUSINESS ELITE	(physician OR doctor OR clinician OR practitioner).ti,ab	111858
☐	53	HMIC, BNI, HEALTH BUSINESS ELITE	50 AND 51 AND 52	32
☐	54	PsycINFO	exp ANTICOAGULANT DRUGS/	317

☐	55	PsycINFO	(warfarin OR coumarins OR anticoagul* OR coagulat).ti,ab [Limit to: Human and English Language]	699
☐	56	PsycINFO	54 OR 55 [Limit to: Human and English Language]	771
☐	57	PsycINFO	exp CEREBROVASCULAR ACCIDENTS/ OR exp ISCHEMIA/	15466
☐	58	PsycINFO	(stroke OR cerebrovascular OR derebrovascular OR ischem*).ti,ab [Limit to: Human and English Language]	20137
☐	59	PsycINFO	57 OR 58 [Limit to: Human and English Language]	21462
☐	60	PsycINFO	56 AND 59 [Limit to: Human and English Language]	333
☐	61	PsycINFO	(atrial ADJ fibrillation OR arrhythmia).ti,ab [Limit to: Human and English Language]	1371
☐	62	PsycINFO	60 AND 61 [Limit to: Human and English Language]	96

☐	62	PsycINFO	60 AND 61 [Limit to: Human and English Language]	96

Appendix 3. Stated study aims.

Author.	Year.	Aims of study.
Abdul-Rahim.	2013	To describe vitamin K antagonist (VKA) anticoagulation prescribing patterns in stroke survivors with atrial fibrillation (AF), with particular emphasis on socio demographic associations with VKA prescription.
AbuDagga.	2014	To identify patient health care providers and health plan factors associated with Dabigatran versus warfarin use in NVAF.
Adderley.	2017	To determine the influence of contraindications on anticoagulant prescribing in patients with AF in the UK.
Adderley.	2018	To determine the age-sex specific prevalence and treatment of AF in the UK from 2000-2016.
Anderson.	2005	To determine the use of antithrombotic therapy of treatment of atrial fibrillation in Nova Scotia. To survey the knowledge of primary & secondary care physicians involved in patient's management.
Apenteng.	2017	To investigate evolving patterns in antithrombotic treatment in UK patients with newly diagnosed nonvalvular atrial fibrillation (AF).
Asim-Khan.	2014	To review current practice in this GP setting to see if national guidelines on atrial fibrillation treatment were being met and patients were on the appropriate treatment depending upon stroke-risk. To determine the reasons for omission of warfarin in high-risk patients. To determine the proportion of patients who did not have a clear reason documented for omission of anticoagulation.
Ashburner.	2017	To examine OAC usage between 2010 and 2015, following the introduction of direct oral anticoagulants (DOACs). To determine if more patients were anticoagulated overtime.
Blich.	2004	To determine the groups of patients less likely to be treated with anticoagulation according to the decisions of the family physician and examine these decisions by means of retrospective follow up
Boulanger.	2006	To assess the patterns and predictors of antithrombotic therapy, the quality of anticoagulation control and the predictors of good control in a large, geographically diverse population of patients with non-valvular AF (NVAF).
Brandes.	2013	To characterize the demographics and stroke-risk profile in an unselected Danish primary care AF-population according to the $CHADS_2$ and $CHA_2DS_2VASC_{risk}$-scores and guideline adherence of antithrombotic treatment initiated by general practitioners (GPs).
Carlsson.	2013	To study time trends in pharmacotherapy in men and women with AF. To assess doctors' adherence to $CHADS_2$ for prescribing warfarin.
Ceresne.	2002	To determine the prevalence of atrial fibrillation in an academic family practice setting. To document the treatments prescribed for this condition.
Clua-Espuny.	2013	To identify the characteristics of the patients with AF not receiving OAT. To determine the reasons for the failure to administer OAT to patients in whom it is indicated.
Cowan.	2012	To investigate the use of oral anticoagulants (AC) and antiplatelet agents (AP) in the management of atrial fibrillation (AF) among patients in primary care in England
Das.	2015	To determine the outcome of an innovative Primary care AF (PCAF) service on anticoagulation uptake in a cohort of high-risk patients with AF in the UK.
Deplanque.	2004	To determine the reasons why stroke patients with a previously known NVAF did not receive OAC before stroke.
DeWilde.	2006	To examine trends in the prevalence of diagnosed AF and of treatment to prevent stroke. To Examine the influence of a range of factors, including stroke risk, on the likelihood of anticoagulant prescription in UK general practice in 2003.
Ding.	2017	To estimate the prevalence of AF and trends of anticoagulation and antiplatelet therapy over time. To determine if treatments are in accordance with stroke and bleeding-risk.
Dinh.	2007	To make an inventory of the demographics of the physicians and their patient population. To describe and compare the antithrombotic treatment patterns in patients with AF in daily clinical practice.
Dreishulte.	2014	To identify patients and practice characteristics associated with the use of anticoagulation.
Ewan.	2012	To identify Warfarin use and interruptions, the quality of anticoagulation, and their relationship with subsequent stroke and bleeding events in nonvalvular atrial fibrillation patients.
FALSTAF study group.	2007	To obtain a current, representative estimate of antithrombotic-use in outpatients with permanent atrial fibrillation. To identify the determinants of their prescription with a prespecified emphasis on the influence of age on the prescription of vitamin K antagonists.

Forslund.	2013	To investigate which implications data from primary care may have for analyses of the $CHADS_2$ and $CHA_2DS_2VASC_{risk}$-scores, and evaluations of the use of thromboprophylactic treatment.
Gallagher.	2008	To evaluate the longitudinal treatment patterns for chronic AF, including predictors for treatment initiation and persistence.
Hannon.	2014	To describe the real-life therapeutic management of non-institutionalized elderly patients with atrial fibrillation according to age-groups, i.e., 65-79 and ≥ 80 years To determine the main factors associated with anticoagulant treatment in both groups.
Holt.	2012	To measure the distribution of stroke-risk in patients with atrial fibrillation (using the $CHADS_2$ and CHA_2DS_2VASC risk-scores) and changes in oral anticoagulant use during 2007–2010
Isaew.	2016	To determine whether patients with paroxysmal atrial fibrillation (AF) are less likely to be treated with anticoagulants than patients with persistent/permanent AF. To investigate trends in treatment between 2000 and 2015. UK and European guidelines recommend that anticoagulants are offered to all patients with AF at increased risk of stroke, irrespective of AF type.
Jacobs.	2009	The aim of this study was to determine the prescribing patterns, risks, and benefits of anticoagulation with warfarin or acetylsalicylic acid (ASA) in elderly patients with AF at risk for stroke and haemorrhage, including those with falls and/or dementia.
Jain.	2017	To examine changes in management of AF prior to stroke, and reasons for suboptimal treatment, in those who were known to be at a high-risk of stroke.
Johansson.	2014	To characterise the individuals without OAC treatment in a real-life population of patients with atrial fibrillation.
Kassianos.	2013	To describe National Health Service (NHS) resource use and pharmacological management of atrial fibrillation (AF) in routine UK primary care.
Lacoin.	2017	To describe the changes in prescribing of oral anticoagulant and antiplatelet agents in patients with non-valvular atrial fibrillation (NVAF) in the UK. To identify the characteristics associated with deviation from guideline-based recommendations.
Lee.	2011	To investigate trends in the burden of stroke between 1999 and 2008.
Leung.	2017	To evaluate prescriber beliefs and trial interpretations influencing OAC prescription across specialties.
Mashal.	2011	To identify patients in the community diagnosed with AF, To assess the prevalence of AF diagnosis, the appropriateness of AF evaluation, the appropriateness and adequacy of the anticoagulation status therapy, and the use of rate and rhythm control
Mazzaglia.	2010	To investigate trends in incidence of diagnosed AF and the effects and range of factors, including a stroke-risk stratification scheme, on the likelihood of the prescription of anti-thrombotics and persistence with OAC treatment in Italian general-practice during the period of 2001-2004.
Murphy.	2007	To examine the epidemiology, primary care burden and treatment of atrial fibrillation (AF).
Murphy.	2018	To examine the factors that influence general practitioners (GPs) when initiating NOAC prescribing in Ireland.
O'Brien.	2014	To describe patterns of documented contraindications to OAC therapy measured at baseline in a large, contemporary outpatient AF cohort. To assess associations between clinical and demographic factors and overall OAC contraindications, according to whether contraindications were related to an active or past clinical condition ("event-related") or were related to patient preference or perceived inability to adhere to the prescribed medication and monitoring regimen ("patient related").
Oswald.	1999	To explore the consequences of introducing an anticoagulation protocol in GP practice. To explore how practitioners, decide on appropriate care considering factors other than the dissemination of evidence.
Pusser.	2005	To measure the current rate of warfarin, use in eligible high-risk AF patients in a large south eastern group family practice. To report the demographics, stroke-risk profiles of patients with AF, and the contraindications and reasons for discontinuation of warfarin therapy.
Robson.	2014	To increase the proportion of people with AF treated appropriately using anticoagulants and reduce inappropriate antiplatelet therapy.
Robson.	2018	To identify reasons for variation between English CCGs in anticoagulation for AF.
Ruigomez.	2002	To describe the characteristics of a population-based cohort of patients with newly diagnosed permanent/chronic atrial fibrillation in general-practice in the UK
Schwill.	2018	To explore changes in prescription rates of OAC in German primary care before and after introduction of NOAC on the market.
Scowcroft.	2012	To examine anticoagulation treatment of elderly patients (80+ years) compared with younger patients (60–69 years, 70–79 years) within a cohort of patients with AF from the UK population, To determine the extent to which any differences in treatment prescribing among different age groups might be explained by bleeding-risk.
Shantasila.	2015	To examine the use of the GRASP-AF tool, utilising the $CHADS_2$ and $CHA_2DS_2VASC_{risk}$-scores to risk stratify patients and identify the choice of antithrombotic therapy received. To determine the predictors of stroke and death in a general-practice cohort in the UK.
Simpson.	2005	To investigate whether sex, age, or deprivation differences exist in the secondary prevention of stroke using a Scottish family practice database.
Smith.	1999	To establish the extent of warfarin use in the elderly over time in conjunction with trial publications.

Sabouret.	2015	To investigate the anticoagulant prescribing behaviour of French GPs and compare them to ESC guidelines for stroke-prevention. To identify major determinants for use of anticoagulation therapy.
Sudlow.	1997	To assess if low treatment anticoagulation treatment rates are affected by the application of exclusion criteria applied from other RCTs of warfarin studies.
Sudlow.	1998	To find out the proportion of patients with AF in a UK population. To find out how many may be likely to benefit from treatment. To find out the likely usefulness of echocardiography in selecting patients for treatment. To determine the prevalence of individual risk-factors for stroke and contraindications to anticoagulation in patients with AF. To find out how these factors contribute to the assessment of eligibility for treatment.
Tomlin.	2017	To estimate the prevalence of atrial fibrillation. To assess patient risk for thromboembolism. To evaluate the appropriateness of risk-reduction using antiplatelet and oral anticoagulation therapy.
Valentinis.	2014	To determine the proportion of patients with atrial fibrillation (AF) in primary care achieving guideline concordant stroke prevention treatment based on both the previous (2010) and the updated (2012) Canadian guideline recommendations.
White.	1999	To determine adherence with practice guidelines by ascertaining the proportion of participants with atrial fibrillation who were taking warfarin in 1995, and to compare the clinical and demographic characteristics of the patients treated with warfarin to those not treated.
Whitford.	2000	Not directly stated.
Willey.	2018	To investigate guideline‐recommended oral anticoagulation (OAC) treatment and persistence in newly diagnosed patients with NVAF. To understand demographic and clinical characteristics.

Appendix 4. Study aims collated.

OAC use. (n=48).	Abdul-Rahim (2013);Adderley (2018); Anderson (2005); Apenteng (2017); Ashburner (2017); Khan (2014); Bahri (2015); Blich (2014); Boulanger (2006); Brandes (2013); Carlsson (2013); Ceresne (2002); Cowan; (2012); Das (2015); DeWilde (2006); Ding (2017); Dinh (2007); Ewan (2012); FALSTAF study group (2007); Forslund (2013); Gallagher (2008); Hannon (2014); Holt (2012); Isaew (2016); Jacobs (2009); Johansson (2014); Kassianos (2013); Lee (2011); Mashal (2011); Mazzaglia (2010); Meinertz (2011); Murphy (2007); Pusser (2005); Robson (2018); Ruigómez (2002); Sabouret (2015); Samsa (2000); Schwill (2018); Scowcroft (2012); Shantasila (2015); Simpson (2005); Smith (1999); Sudlow (1997); Sudlow (1998); Tomlin (2017); Valentinis (2014); White (1999); Willey (2018).
Use of guidelines. (n=16).	Brandes (2013); Carlsson (2013); Ding (2017); Isaew (2016); Khan (2014); Lacoin (2017); Mashal (2011); Mazurek (2017); O'Brien (2014); Ogilvie (2009); Sabouret (2015); Shantasila (2015); Smith (1999); Sudlow (1997); Valentinis (2014); White (1999).
Reasons for underuse. (n=12).	Bahri (2015); Clua-Espuny (2013); Deplanque, (2004); Hannon (2014); Jain (2017); Khan (2014); Lacoin (2017); O'Brien (2014); Pusser (2005); Scowcroft (2012); Simpson (2005); Sudlow (1998).
Profiling stroke-risk. (n=10)	Brandes (2013); Ding (2017); Dreishulte (2014); Forslund (2013); Holt (2012); Khan (2014); Mazzaglia (2010); Pusser (2005); Sudlow (1998); Tomlin (2017).
AF prevalence. (n=8).	Adderley (2018); Ceresne (2002); DeWilde (2006); Mashal (2011); Mazzaglia (2010); Murphy (2007); Sudlow (1998); Tomlin (2017).
OAC underuse. (n=8).	Blich (2014); Clua-Espuny (2013); FALSTAF study group (2007); Gallagher (2008); Johansson (2014); Khan (2014); O'Brien (2014); White (1999).
Demographic inventory. (n=5).	Adderley (2018); Dinh (2007); Dreishulte (2014); Ruigómez (2002); Sudlow (1998).
Direct anticoagulants. (n=5).	AbuDagga (2014); Ashburner (2017); Murphy (2018); Schwill (2018); Willey (2018).
OAC practice change. (n=4).	Das (2015); Oswald (1999); Robson (2014); Shantasila (2015).
Stroke. (n=4).	Jain (2017); Lee (2011); Shantasila (2015); Simpson (2005).
Assessing clinician knowledge. (n=3).	Anderson (2005); Leung (2017); Murphy (2018).
OAC control. (n=3).	Boulanger (2006); Ewan (2012); Samsa (2000).
Bleeding-risk. (n=2).	Ding (2017); Scowcroft (2012).
OAC persistence. (n=2).	Gallagher (2008); Willey (2018).
AF type and treatment. (n=1).	Isaew (2016).
Contraindication and use. (n=1).	Adderley (2018).
Dementia and use. (n=1).	Viscogliosi (2017).
Not directly stated. (n=1).	Whitford (1999).

Appendix 5. Variables used to measure OAC use across studies.

Age. (n=35).	Abdul-Rahim (2013); Apenteng (2017); Bahri (2015); Blich (2014); Brandes (2013); Boulanger (2006); Cowan (2012); Deplanque (2004); Ding (2017); Dinh (2007); Dreishulte (2014); Ewen (2012); FALSTAF study group (2007); Forslund (2013); Gallagher (2008); Hannon (2014); Jacobs (2009); Jain (2017); Johansson (2014); Lacoin (2017); Mazurek (2017); Mazzaglia (2010); Murphy (2007); O'Brien (2014); Oswald (1999); Robson (2014); Sabouret (2015); Scowcroft (2012); Simpson (2005); Sudlow (1998); Tomlin (2017); Viscogliosi (2017); White (1999); Whitford (2000); Willey (2017).
Age group specific. (n=29).	AbuDagga (2014); Apenteng (2017); Bahri (2015); Boulanger (2006); Brandes (2013); Cowan (2012); Ding (2017); Deplanque (2004); Ewen (2012); FALSTAF study group (2007); Hannon (2014); Jacobs (2009); Jain (2017); Johansson (2014); Lacoin (2017); Mazurek (2017); Mazzaglia (2010); Murphy (2007); Oswald (1999); Robson (2014); Sabouret (2015); Scowcroft (2012); Simpson (2005); Sudlow (1997); Tomlin (2017); Viscogliosi (2017); White (1999); Whitford (2000); Willey (2018).
Gender. (n=26).	AbuDagga (2014); Adderley (2018); Apenteng (2017); Bahri (2015); Blich (2014); Boulanger (2006); Carlsson (2013); Clua-Espuny (2013); Deplanque (2004); Dinh (2007); Dreishulte (2014); Forslund (2013); Gallagher (2008); Jain (2017); Johansson (2014); Lacoin (2017); Lee (2011); Mazzaglia (2010); Murphy (2007); O'Brien (2014); Sabouret (2015); Scowcroft (2012); Simpson (2005); Sudlow (1998); Tomlin (2017); Willey (2018).
OAC use/non-use. (n=15).	Ceresne (2002); Khan (2014); Mashal (2011); Murphy (2007); Oswald (1999); Pusser (2005); Ruigómez (2002); Scowcroft (2012); Simpson (2005); Smith (1999); Sudlow (1998); Valentinis (2014); White (1999); Whitford (2000); Willey (2018).
Stroke/TIA. (n=15).	AbuDagga (2014); Adderley (2018); Apenteng (2017); Bahri (2015); Boulanger (2006); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Jain (2017); Lacoin (2017); Lee (2011); Mazzaglia (2010); Sabouret (2015); Tomlin (2017); Willey (2018).
Heart failure. (n=14).	Abdul-Rahim (2013); AbuDagga (2014); Adderley (2018); Apenteng (2017); Bahri (2015); Boulanger (2006); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Lacoin (2017); Mazzaglia (2010); Sabouret (2015); Tomlin (2017); Willey (2018).
Diabetes. (n=13).	Abdul-Rahim (2013); AbuDagga (2014); Adderley (2018); Apenteng (2017); Bahri (2015); Boulanger (2006); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Mazzaglia (2010); Sabouret (2015); Tomlin (2017); Willey (2018).
Hypertension. (n=13).	AbuDagga (2014); Adderley (2018); Apenteng (2017); Bahri (2015); Boulanger (2006); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Jain (2017); Mazzaglia (2010); Sabouret (2015); Tomlin (2017); Willey (2018).
CHA_2DS_2VASC. (n=12).	Abdul-Rahim (2013); Adderley (2018); Apenteng (2017); Ashburner (2017); *Bahri (2015); Ding (2017); Lacoin (2017); Robson (2014); Scowcroft (2012); Sabouret (2015); Tomlin (2017); Willey (2018). (*mean score only)
$CHADS_2$. (n=10).	Abdul-Rahim (2013); AbuDagga (2014); Adderley (2018); Cowan (2012); Ding (2017); Gallagher (2008); Isaew (2016); *Sabouret (2015); Scowcroft (2012); Willey (2018). *$CHADS_2$ score> 1
Neurological diseases/Dementia/Cognitive impairment /Depression. (n=8).	Abdul-Rahim (2013); Adderley (2018); Apenteng (2017); Bahri (2015); Boulanger (2006); Gallagher (2000); Jacobs (2009); Sabouret (2015).

Peripheral artery disease. (n=7).	Adderley (2018); Clua-Espuny (2013); Dinh (2007); Lacoin (2017); Mazzaglia (2010); Sabouret (2015); Willey (2018).
Geographical location. (n= 6).	AbuDagga (2014); Boulanger (2006); Gallagher (2008); Lacoin (2017); Murphy (2007); Robson (2018).
Number of unique medicines. (n=6).	AbuDagga (2014); Boulanger (2006); DeWilde (2006); Dreishulte (2014); Lacoin (2017); Willey (2018).
Peripheral embolism/Venous thromboembolism. (n=6).	Bahri (2015); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Sabouret (2015); Willey (2018).
AF type. (n=5).	Adderley (2018); Bahri (2015); Isaew (2017); Johansson (2014); Sabouret (2015).
Coronary heart disease/Myocardial infarction. (n=5).	Bahri (2015); Carlsson (2013); Clua-Espuny (2013); Dinh (2007); Willey (2018).
Past episode of bleeding. (n=5).	Abdul-Rahim (2013); Apenteng (2017); Bahri (2015); Blich (2014); Lacoin (2017).
Physician type. (n=5).	AbuDagga (2014); Apenteng (2017); Dinh (2007); Leung (2017); Willey (2018).
Socioeconomic deprivation. (n=5).	Abdul-Rahim (2013); Dreishulte (2014); Gallagher (2008); Jain (2017); Murphy (2007).
A combined comorbidity score: *Deyo-Charlson co-morbidity index (CMI/*¥Elixhauser co-morbidity index (ECI). (n=4).	Abdul-Rahim (2013); *Bahri (2015); DeWilde (2006); Willey (2018). ¥*
Acute myocardial infarction/CAD. (n=4).	Adderley (2018); Lacoin (2017); Sabouret (2015); Willey (2018).
Body mass index. (n=4).	Adderley (2018); Abdul-Rahim (2013); Blich (2014); Gallagher (2008).
Falls. (n=4).	Bahri (2015); Gallagher (2008); Jacobs (2009); Lacoin (2017).
HASBLED score. (n=4).	Abdul-Rahim (2013); Apenteng (2017); Ding (2017); Scowcroft (2012).
OAC use over time. (n=4).	Isaew (2017); Lacoin (2017); Robson (2018); Smith (1999).
Renal disease. (n=4).	AbuDagga (2014); Apenteng (2017); Lacoin (2017); Willey (2018).
Smoking. (n=4).	Abdul-Rahim (2013); Apenteng (2017); Blich (2014); Gallagher (2008).
Use of NSAIDS. (n=4).	AbuDagga (2014); Adderley (2018); Apenteng (2017); Sabouret (2015).
Valvular disease. (n=4).	Apenteng (2017); Carlsson (2013); Dinh (2007); Tomlin (2017).
Blood pressure/Systolic BP. (n=3).	Adderley (2018); Abdul-Rahim (2013); Sabouret (2015).
Education. (n=3).	Blich (2014); Carlsson (2013); Deplanque (2004).
Intracranial bleed. (n=3).	Carlsson (2013); Jain (2017); Lacoin (2017).
Liver disease. (n=3).	Boulanger (2006); Lacoin (2017); Willey (2018).
Number of CIS. (n=3).	Dreishulte (2014); Dinh (2007); O'Brien (2014).
Peptic/gastric Ulcer. (n=3).	Boulanger (2006); Lacoin (2017); Willey (2018).
Type of treatment used. (n=3).	AbuDagga (2014); Blich (2014); Schwill (2018).
%$CHADS_2$ =>2. (n=3).	Holt (2012); Kassianos (2013); Willey (2018).
Bleeding episode/Other types. (n=2).	Blich (2014); Lacoin (2017).
Cardiomyopathy. (n=2).	Carlsson (2013); Willey (2018).
Date of AF diagnosis. (n=2).	Blich (2014); Mazzaglia (2010).
Date of thrombolytic event. (n=2).	Blich (2014); Jain (2017).
Ethnicity. (n=2).	Jain (2017); Tomlin (2017).
Exceptions to OAC use. (n=2).	Adderley (2017); Robson (2018).
GP protocol for OAC. (n=2).	Das (2015); Oswald (1999).
Insurance plans. (n=2).	AbuDagga (2014); Willey (2018).
Marital status. (n=2).	Carlsson (2013); Deplanque (2004).

Number of warfarin interacting medicines. (n=2).	*Bahri (2015); Gallagher (2008). *Mean number of meds
Time since AF diagnosis. (n=2).	Bahri (2015); Lacoin (2017).
Use of anti-arrhythmic drugs. (n=2).	AbuDagga (2014); Sabouret (2015).
Use of antiplatelet. (n=2).	Abdul-Rahim (2013); Robson (2014).
Warfarin in use exposure. (n=2).	Ewen (2012); Lacoin (2017).
Alcohol use/units. (n=1).	Jain (2017).
COPD/Emphysema. (n=1).	Willey (2018).
Date of birth. (n=1).	Clua-Espuny (2013).
Death versus OAC use. (n=1).	Shantasila (2015).
Disability. (n=1).	Abdul-Rahim (2013).
Duration of AF >10 years. (n=1).	Abdul-Rahim (2013).
GORD/Dyspepsia. (n=1).	Willey (2018).
GP attitudes. (n=1).	Murphy (2018).
Habitation circumstances. (n=1).	Deplanque (2004).
HAEMORR2HAGES score. (n=1).	Willey (2018).
Hypercholesterolemia. (n=1).	Willey (2018).
INR. (n=1).	Blich (2014).
Malnourished. (n=1).	Bahri (2015).
NICE criteria. (n=1).	Abdul-Rahim (2013).
NOAC only. (n=1).	Lacoin (2017).
Number of stroke-risk factors. (n=1).	Dreishulte (2014).
Number of warfarin interruptions. (n=1).	Ewen (2012).
Obesity. (n=1).	Abdul-Rahim (2013).
Population size of the GP. (n=1).	Gallagher (2008).
Seizure. (n=1).	Boulanger (2006).
Stroke-risk. (n=1).	Brandes (2013).
Stroke versus OAC use. (n=1).	Shantasila (2015).
Systemic embolism. (n=1).	Adderley (2018).
Warfarin use < 12/12 of AF diagnosis? (n=1).	Scowcroft (2012).
%CHA_2DS_2VASC > 2. (n=1).	Holt (2012).

Appendix 6. Exclusion criteria used.

No exclusions stated. (n=16).	Ashburner (2017); Clua-Espuny (2013); Cowan (2012); DeWilde (2006); Ding (2017); Isaew (2016); Johansson (2014); Leung (2017); Murphy (2007); O'Brien (2014); Kassianos (2017); Robson (2014); Tomlin (2017); Whitford (2000); Mazurek (2017); Meinertz (2011).
AF resolved/transient. (n=12).	Adderley (2017); Adderley (2018); Apenteng (2017); Asim-Khan (2014); Boulanger (2006); Ceresne (2002); Das (2015); Dreishulte (2014); Ewan (2012); Hannon (2014); Pusser (2005); Samsa (2000).
Patients before and between specific dates. (n=7).	AbuDagga (2014); Apenteng (2017); Gallagher (2008); Jain (2017); Mazzaglia (2010); Schwill (2018); Shantasila (2015).
Patients <18 years. (n=7).	AbuDagga (2014); Dinh (2007); Ewan (2012); Kassianos (2013); Lacoin (2017); Sabouret (2015); Willey (2018).
Nursing home patients. (n=5).	Abdul-Rahim (2013); Anderson (2005); Hannon (2014); Smith (1999); White (1999).
Rheumatic heart disease/Artificial valves. (n=5).	AbuDagga (2014); Blich (2004); Lacoin (2017); Willey (2018); Viscogliosi (2017).
Cancer/Active cancer. (n=4).	Ruigómez (2002); Smith (1999); White (1999); Viscogliosi (2017).
PAF. (n=4).	FALSTAF study group (2000); Gallagher (2008); Pusser (2005); Ruigómez (2002).
Patient's life threatening non-cardiac conditions. (n=4).	Hannon (2014); Smith (1999); Sudlow (1997); White (1999).
Patients refuses/unable to give consent. (n=4).	Anderson (2005); Dinh (2007); Hannon (2014); Sudlow (1997).
Cardiac surgery within 12/12. (n=3).	Sudlow (1997); Willey (2018); Viscogliosi (2017).
Hyperthyroid. (n=3).	AbuDagga (2014); Ewan (2012); Willey (2018).
Mitral stenosis. (n=3).	Forslund (2013); Gallagher (2008); Willey (2018).
AF diagnosis <3/12. (n=2).	Jacobs (2009); Kassianos (2013).
AF not determined ECG/otherwise. (n=2).	Das (2015); Deplanque (2004).
Alcoholism/Daily alcohol consumption>13 g for women and>26 g for men in the last 3 months. (n=2).	Sudlow (1997); Viscogliosi (2017).
Anaemia/Haemoglobin<10 g/dl. (n=2).	Sudlow (1997); Viscogliosi (2017).
Cardioverted patients. (n=2).	Jacobs (2009); Sudlow (1997).
Chronic renal failure. (n=2).	Sudlow (1997); Viscogliosi (2017).
Family physician refused consent. (n=2).	Anderson (2005); Sudlow (1997).
Major or recent bleeding. (n=2).	Das (2015); Viscogliosi (2017).
Mechanical pacing devices. (n=2).	Smith (1999); White (1999).
Non-ischaemic stroke. (n=2).	Das (2015); Simpson (2005).
Patients too ill to follow up. (n=2).	Apenteng (2017); Smith (1999).
Recent surgery (within 1 month). (n=2).	FALSTAF study group (2000); Hannon (2014).
Receiving Warfarin for other reasons. (n=2).	Sudlow (1997); White (1999).
"*Secondary*" AF. (n=2).	Apenteng, 2017. Kassianos, 2013
<35 years. (n=2).	Adderley (2017); Adderley (2018)

VTE within last 12/12. (n=2).	Sudlow (1997); White (1999).
Wheelchair bound/immobile. (n=2).	White (1999); Viscogliosi (2017).
Non-resident of Nova Scotia. (n=1).	Anderson (2005).
No pre-stroke treatment details. (n=1).	Ogilvie (2009).
No stroke-risk stratification. (n=1).	Ogilvie (2009).
Patients in a trial. (n=1).	Hannon (2014).
Patients NOT receiving antithrombotic. (n=1).	Jacobs (2009).
Patients requiring NSAIDS. (n=1).	Sudlow (1997).
Peptic ulcer. (n=1).	Viscogliosi (2017).
Pericarditis/Myocarditis. (n=1).	Willey (2018).
Previous anticoagulant treatment discontinued for any reason. (n=1).	Viscogliosi (2017).
Previously unknown AF. (n=1).	Deplanque (2004).
Pulmonary embolism. (n=1).	Willey (2018).
Receiving antithrombotic medications only. (n=1).	Jacobs (2009).
Stroke within last 12/12. (n=1).	Sudlow (1997).
Taking warfarin for other medical problems. (n=1).	Asim-Khan (2014).
The Neuropsychiatric Inventory (NPI) score>2 in 3 or more items. (n=1).	Viscogliosi (2017).
TIA. (n=1).	Sudlow (1997).
Unable to speak English. (n=1).	Anderson (2005).
Uncontrolled blood pressure. (n=1).	Viscogliosi (2017).
Unknown gender. (n=1).	Lacoin (2017).

Appendix 7. Sampling methods used.

Author.	Year.	Sampling used.
Abdul-Rahim.	2013	All eligible patients included.
AbuDagga.	2014	All atrial fibrillation patients with OAC medication claims reviewed.
Adderley.	2017	All atrial fibrillation patients reviewed.
Adderley.	2018	All atrial fibrillation patients reviewed between the set dates.
Anderson.	2005	Patients identified through ECG attendances > family physicians contacted>State-wide postal survey of physicians.
Apenteng.	2017	Patients identified by their GPs and then invited to participate via the GARFFIELD registry.
Ashburner.	2017	All atrial fibrillation patients reviewed.
Asim-Khan.	2014	All atrial fibrillation patients reviewed.
Bahri.	2015	All atrial fibrillation patients reviewed.
Blich.	2004	Retrospective analysis of all atrial fibrillation NVAF patients within the 23 primary health care clinics. – Non-random.
Boulanger.	2006	All eligible patients on data base Non-randomised.
Brandes.	2013	Eligible patients were randomly selected to avoid selection bias.
Carlsson.	2013	1330 male, 1096 female 2002.
Ceresne.	2002	All patients screened for possible codes of AF.
Clua-Espuny.	2013	A randomized sample of 1043 patient over the age of 60 years who resided in the Baix Ebre region, from each primary care centre.
Cowan.	2012	1857 general-practices in England with patients coded with atrial fibrillation whose data was uploaded and shared using GRAS-atrial fibrillation tool.
Das.	2015	Practices identified through systematic marketing and voluntary enrolled. Patients identified through the GRASP-AF tool and invitation.
Deplanque.	2004	5-12 consecutive atrial fibrillation patients from each study site.
DeWilde.	2006	All patients on the database between study periods.
Ding.	2017	All AF patients enrolled in the Swedish national study on ageing and care in Kungsholmen, stratified into age groups.
Dinh.	2007	5-10 consecutive atrial fibrillation patients at each location.
Dreishulte.	2014	All patients who met the inclusion/exclusion criteria included.
Ewan.	2012	Consecutive hospital admissions of chronic NVAF on presentation to this hospital to see how many had received warfarin prophylaxis in the community.
FALSTAF study group.	2007	Consecutive atrial fibrillation patients.
Forslund.	2013	All patients within the study period on database included.
Gallagher.	2008	All chronic AF patients on database.
Hannon.	2014	Participating GPs were asked to recruit between 3-10 consecutive atrial fibrillation patients who met the inclusion criteria.
Holt.	2012	All available records were included in this study.
Isaew.	2016	All AF patients on database.
Jacobs.	2009	112 eligible pats in the index period.
Jain.	2017	All patients with AF included on an existing stroke register.

Johansson.	2014	All patients on the register with a diagnosis confirmed atrial fibrillation.
Kassianos.	2013	The general practitioner identified AF patients on their lists, invited them to participate by post.
Lacoin.	2017	All patients on the register with a diagnosis confirmed atrial fibrillation.
Lee.	2011	Uses the General-practiceResearch Database (GPRD) included the possibility of first strokes.
Leung.	2017	All clinicians associated with locally with the research hub surveyed by a secure, web‐based application (www.SurveyMonkey.com).
Mashal.	2011	AF codes.
Mazurek.	2017	All atrial fibrillation patients reviewed.
Mazzaglia.	2010	Data from a primary care database consisting of 800 primary care providers. Form a total sample of 488,231 patients.
Meinertz.	2011	The first 730 respondents were offered participation.
Murphy.	2007	All AF coded.
Murphy.	2018	All GPs listed in the telephone directory were contacted for sampling.
O'Brien.	2014	Participating sites were selected to be geographically representative and to include adverse set of providers who manage AF patients.
Ogilvie.	2009	Papers which included AF, risk scoring and pre‐stroke OAC use data.
Oswald.	1999	6 GP-practice locally purposively sampled who had electronic systems. All invited to partake.
Pusser.	2005	Screened all patients in the clinic in the s‐years of study by billing systems. No treatment protocol was used – only referred to current guidelines.
Robson.	2014	All atrial fibrillation patients reviewed.
Robson.	2018	All AF data held on CCG databases.
Ruigómez.	2002	Database: Retrospective cohort stud y‐ included all patients registered with a GP for previous 2 years and 1‐year history of warfarin prescription.
Sabouret.	2015	All atrial fibrillation patients reviewed.
Samsa.	2000	All atrial fibrillation patients reviewed.
Scowcroft.	2012	GPRD used to sample atrial fibrillation patients. Patients who were initiated on warfarin identified.
Schwill.	2018	All atrial fibrillation patients reviewed.
Shantasila.	2015	The study population was derived from all patients who were registered at one of 11 general-practices. Data were collected primarily using the GRASP‐AF audit tool.
Simpson.	2005	Identified all patients registered with the practices on March 31, 2004 who had ever had a computer record of transient cerebral ischemia or any stroke. (Read code of G6).
Smith.	1999	A stratified random sample from a population –based, prospective cohort study.
Sudlow.	1997	Age/sex stratified random population sample.
Sudlow.	1998	Random sampling of 4843 patients > 65 years performed by letter invite – using ECG.
Tomlin.	2017	All atrial fibrillation patients reviewed in volunteering practices.
Valentinis.	2014	Large urban community family practice in downtown Toronto spread across 2 locations, with 14 family physicians and more than 18 000 registered patients.
Viscogliosi.	2017	Participants were selected from among older community‐dwelling subjects referred by their primary care provider
White.	1999	A stratified random sample from a population –based, prospective cohort study.
Whitford.	2000	All patients on the atrial fibrillation caseload where included.
Willey.	2018	All newly diagnosed patients with NVAF with ≥2 medical claims with a diagnosis of AF.

Appendix 8. Methods of identifying AF within the sample.

Author.	Year of publication.	Atrial fibrillation by type.	Atrial fibrillation diagnosis.	Warfarin use measured by *specifics not stated.
AbuDagga.	2014	-	ICD-9 Read-codes.	At least two prescription claims in 2 years for AF drugs.
Abdul-Rahim.	2013	Yes.	Read-codes.	At least one prescription for warfarin or other VKA within the 1-year period.
Adderley.	2017	-	Read-codes.	Prescription data.*
Adderley.	2018	Yes.	Read-codes.	Patient prescription data.*
Anderson.	2005	-	ECG.	Clinician data.*
Apenteng.	2017	-	Read-codes.	Patient prescription data.*
Ashburner.	2017	-	ICD-9 10 Read-code.	Patient prescription data.*
Bahri.	2015	Yes.	Read-codes.	Prescriptions in the last 3 months.
Blich.	2004	Yes.	Not stated.	Not stated.
Boulanger.	2006	-	ICD-9-CM 427.3x Read-code.	Prescription data.*
Brandes.	2013	-	Read-codes and free text searches.	Prescription data.*
Carlsson.	2013	-	ICD-10 Read-code.	Prescription data.*
Ceresne.	2002	Yes.	ICD-9-CM 427.31 or 427.32 Read-codes.	Codes and OAC clinic searches.*
Clua-Espuny.	2013	Yes.	ECG.	Prescription data.*
Cowan.	2012	-	Read-code.	A prescription for anticoagulant in the last 6 months (warfarin, Acenocoumarin, Phenindione, Dabigatran, Rivaroxaban and Apixaban).
Das.	2015	-	GRASP-AF (uses Read-codes and Digoxin use).	Prescription data.*
Deplanque.	2004	Yes.	ECG.	Admission records, INR status.
DeWilde.	2006	Yes.	(ICD-9-CM) Read-code Clinician could indicate atrial fibrillation type.	Read codes.*
Ding.	2017	-	ECG and or ICD-10 Read-code.	ATC codes (B01AN /B01AC).*
Dinh.	2007	-	Questionnaire response.	Questionnaire responses.
Dreishulte.	2014	Yes.	Read-codes.	Prescriptions in the last 3 months.
Ewan.	2012	-	ECG.	Prescription sheets *INR values with gaps up to 45 days with each category.
FALSTAF study group.	2007	CAF only.	Not stated.	Not stated.
Forslund.	2013	-	ICD-10 Read-code.	The Prescribed Drug Register.*
Gallagher.	2008	CAF only.	Read-codes.	Prescription data held on database up to 90 days.
Hanon.	2014	Yes.	ECG/codes.	Not stated.
Holt.	2012	-	Read-code.	Not stated.
Isaew.	2016	Yes.	Read-codes.	Prescription for any anticoagulant drug (including warfarin, parenteral anticoagulants, other vitamin K antagonists and new oral anticoagulants) within 90 days prior to the index date or a

				clinical code indicating provision of anticoagulant therapy within 365 days prior to the index date.
Jacobs.	2009	-	ECG.	Prescription data.*
Jain.	2017	-	Read-codes.	Not stated.
Johansson.	2014	Yes.	Atrial fibrillation first episode in study period. Read-code.	Not directly stated.*
Khan.	2014	-	Read-codes.	Case notes review.*
Kassianos.	2013	Yes.	Read codes.	Prescription data on the last 3 years or the latest 3 months with new NVAF patients.
Lacoin.	2017	-	Read-codes.	Prescription data (last 90 days).
Lee.	2011	-	Read-codes.	Prescription data.*
Leung.	2017	n/a.	n/a.	n/a.
Mashal.	2011	-	Read-codes.	Prescription data INR values over last 3 months.
Mazurek.	2017	-	GRASP-AF (Read-code not stated).	Prescription data.*
Mazzaglia.	2010	-	ICD-9 Read-code.	Prescription data.*
Meinertz.	2011	Yes.	ECG.	Prescription data.*
Murphy.	2007	-	Read-codes.	Prescription data.*
Murphy.	2018	n/a.	n/a.	n/a.
O'Brien.	2014	-	Not stated.	Not stated.
Ogilvie.	2009	-	n/a.	n/a.
Oswald.	1999	-	GP self-reporting.	GP self-reporting.*
Pusser.	2005	Yes.	ICD-9 Read-code.	Prescription data.*
Robson.	2014	-	Read-codes.	At least one prescription in the last 6 months.
Robson.	2018	-	Read-codes.	Prescription data.*
Ruigómez.	2002	CAF only.	Read-codes – GP confirmed.	Prescription data three months period.
Samsa.	2000	-	Read-codes, ECG.	Prescription billing claims- period not stated.
Sabouret.	2015	-	Not stated.	Not stated.
Schwill.	2018	-	AF (ICD I48.0) Read-code.	[Phenprocoumon=ATC-B01AA04] and NOAC [Apixaban=ATC-B01AX08, Dabigatran=ATC-B01AE07, Rivaroxaban=ATC-B01AX06] and ASA [acetylsalicylic-acid=ATC-B01AC06].
Scowcroft.	2012	-	Read-codes.	Prescription data - first prescription for warfarin (if within 12months of diagnosis).

Shantasila.	2015	-	Read-codes.	Not stated.
Simpson.	2005	-	Not described.	Not stated.
Smith.	1999	-	ECG.	Self-reported use by patients by supplying evidence of usual prescriptions taken in the last 2 weeks.
Sudlow.	1997	-	ECG.	GP questionnaires.*
Sudlow.	1998	-	ECG.	Not stated.
Tomlin.	2017	-	Read-codes.	Patients with three or more prescriptions for these drugs in the previous 14 months or, in the case of warfarin, patients with more than 200 tablets prescribed in the previous 312 European Journal of Preventive Cardiology 24(3) 14 months.
Valentinis.	2014	-	ECG and free text searching Problem list a fib, afib, a-fib, atrial fib, 427, a. fib, a.fib, fibrillation, a.f., flutter, parox, AF-, AF: Past medicalhistory: a fib, afib, a-fib, atrial fib, a. fib, a.fib, fibrillation, a.f., flutter, parox, AF-, AF: Text notes afib, a-fib, atrial fib, a. fib, a.fib, fibrillation, a.f., atrial flutter Billing code 427.	Free text searching.*
Viscogliosi.	2017	Yes.	Documented diagnosis confirmed by ECG.	Prescription data.*
White.	1999	Yes.	ECG.	Medication use was determined by direct review of all drugs each participant was taking at the time of the examination.
Whitford.	2000	-	Not stated.	Not stated.
Willey.	2018	-	ICD-9 Read-code.	Patients with ≥1 pharmacy claim(s) for any OAC during the patient identification period, and a medical claim for an AF diagnosis on or within 90 days.

Appendix 9. Contraindications cited.

Contraindication Cited.	Paper who cite specific contraindication.
Contraindication not. (n=27).	Adderley (2018); Anderson (2005); Ashburner (2017); Blich (2004); Carlsson (2013); Ceresne (2002); Cowan (2012); FALSTAF study group (2007); Forslund (2013); Gallagher (2008); Jacobs (2009); Jain (2017); Kassianos (2013); Khan (2014); Lee (2011);Leung (2011); Mashal (2011); Mazurek (2012) Murphy (2007); Murphy (2018); Oswald (1999); Sabouret (2015); Shantasila (2015); Simpson (2005); Valentinis (2014); Whitford (2000).
Bleeding episode. (n=20).	AbuDagga (2014); Adderley (2017); Abdul-Rahim (2013); Brandes (2013); Ceresne (2002); Clua-Espuny (2013); Das (2015); Deplanque (2004); Dinh (2007); Ewen (2012); Hanon (2014); Holt (2012); Isaew (2016); O'Brien (2014); Pusser (2005); Robson (2014); Ruigómez (2002); Samsa (2000); Sudlow (1997); Viscogliosi (2017).
Excessive alcohol. (n=20).	Abdul-Rahim (2013); Brandes (2013); Ceresne (2002); Clua-Espuny (2013); Deplanque (2004); DeWilde (2006); Ewen (2012); Hanon (2014); Holt (2012); Johansson (2014); Pusser (2005); Ruigómez (2002); Scowcroft (2012); Smith (1999); Sudlow (1997); Sudlow (1997); Viscogliosi (2017); White (1999); Willey (2018).
Renal disease (CKD). (n=15).	AbuDagga (2014); Brandes (2013); Clua-Espuny (2013); Dinh (2007); Ewen (2012); Hanon (2014); Holt (2012); Johansson (2014); Pusser; (2005); Ruigómez (2002); Scowcroft (2012); Abdul-Rahim (2013); Sudlow (1997); Viscogliosi (2017); Willey (2018).
Hypertension (uncontrolled or malignant). (n=14).	AbuDagga (2014); Abdul-Rahim (2013); Adderley (2017); Ceresne (2002); Clua-Espuny (2013) Hanon (2014); Holt (2012); Isaew (2016); Ruigómez (2002); Scowcroft (2012); Hanon (2014); Sudlow (1997); Viscogliosi (2017); Willey (2018).
Tendency to fall. (n=13).	Brandes (2013); Deplanque (2004); Dinh (2007); Ewen (2012); Holt (2012); O'Brien (2014); Pusser (2005); Ruigómez (2002); Samsa (2000); Smith (1999); Sudlow (1997); Viscogliosi (2017); Willey (2018).
Cirrhosis of the liver (abnormal bloods). (n=8).	Abdul-Rahim (2013); Boulanger (2006); Clua-Espuny (2013); Ewen (2012); Hanon (2014); Pusser (2005); Ruigómez (2002); Scowcroft (2012).
Stroke. (n=8).	Abdul-Rahim (2013); Ceresne (2002); Hanon (2014); Scowcroft (2012); Clua-Espuny (2013); Hanon (2014); Sudlow (1997); Willey (2018).
Drugs used (types and polypharmacy). (n=10).	Abdul-Rahim (2013); Brandes (2013); Ceresne (2002); Clua-Espuny (2013); Deplanque (2004); DeWilde (2006); Hanon (2014); Holt (2012); Mazzaglia (2011); Scowcroft (2012).
Gastro tract disease (PUD, GORD, Varices). (n=10).	Adderley (2017); DeWilde (2006); Dinh (2007); Ewen (2012); Holt (2012); Isaew (2016); Mazzaglia (2011); Pusser (2005); Ruigómez (2002); Viscogliosi (2017).
Age>75. (n=7).	Adderley (2014); Abdul-Rahim (2013); Ceresne (2002); Clua-Espuny (2013); Hanon (2014); Scowcroft (2012); Willey (2018).
Dementia. (n=7).	Boulanger (2006); Dinh (2007); Dreishulte (2014); Holt (2012); Johansson (2014); Pusser (2005); Sudlow (1997).
Hepatic disorder. (n=7).	Brandes (2013); Dinh (2007); Ewen (2012); Hanon (2014); Holt (2012); Johansson (2014); Viscogliosi (2017); Willey (2018).
NSAIDS. (n=7).	Brandes (2013); Clua-Espuny (2013); Deplanque (2014); DeWilde (2006); Holt (2012); Ruigómez (2002); Sudlow (1997); Sudlow (1997).
Thrombocytopenia. (n=7).	Adderley (2014); Brandes (2013); Dinh (2007); Pusser (2005); Samsa (2000); Sudlow (1997); Willey (2018).
Unwillingness /refusal. (n=7).	Dinh (2007); Johansson (2014); O'Brien (2014); Pusser (2005); Robson (2018); Samsa (2000); Sudlow (1997).
Warfarin Allergy. (n=7).	Adderley (2017); Holt (2012); Isaew (2016); Johansson (2014); O'Brien (2014); Pusser (2005); Samsa (2000).
Active malignancy. (n=6).	Brandes (2013); Dinh (2007); Holt (2012); Sudlow (1997); Viscogliosi (2017); Willey (2018).
Anaemia. (n=6).	AbuDagga (2014); DeWilde (2006); Holt (2012); Samsa (2000); Viscogliosi (2017); Willey (2018).
Cognitive dysfunction. (n=6).	Dinh (2007); Johansson (2014); Samsa (2000); Smith (1999); Viscogliosi (2017); White (1999).
Haemorrhagic stroke. (n=6).	Dinh (2007); Holt (2012); Mazzaglia (2011); O'Brien (2014); Pusser (2005); Ruigómez (2002).
Perceived barriers to compliance. (n=6).	Ewen (2012); Johansson (2014); O'Brien (2014); Sudlow (1997); Sudlow (1997); Viscogliosi (2017).

Physician preference. (n=6).	Dinh (2007); Mazzaglia (2011); O'Brien (2014); Sudlow (1997); Sudlow (1997); Valentinis (2014).
Unstable INR. (n=6).	Abdul-Rahim (2013); Brandes (2013); Clua-Espuny (2013); Hanon (2014); Samsa (2000); Scowcroft (2012).
Bleeding /bruising tendency. (n=5).	Holt (2012); Johansson (2014); O'Brien (2014); Scowcroft (2012); Smith (1999).
Coagulation defects. (n=5).	Adderley (2017); Mazzaglia (2011); Pusser (2005); Ruigómez (2002); Viscogliosi (2017).
Terminal illness. (n=5).	Holt (2012); Johansson (2014); Pusser (2005); Robson (2018); Sudlow (1997).
Types of bleeding stated. (n=5).	Deplanque (2014); Ewen (2012); Holt (2012); Pusser (2005); Sudlow (1997).
Aneurysm. (n=4).	Adderley (2017); Isaew (2016); Samsa (2000); Viscogliosi (2017).
Haemorrhagic stroke or intracranial haemorrhage. (n=4).	Adderley (2017); Das (2017); Isaew (2016); Samsa (2000).
Pregnancy. (n=4).	Adderley (2014); Isaew (2016); O'Brien (2014); Samsa (2000).
Ulcer. (n=4).	Boulanger (2006); DeWilde (2006); Dinh (2007); Dreishulte (2014).
Haemorrhagic disease. (n=3).	Ruigómez (2002); Samsa (2000); Viscogliosi (2017).
Isolated/transient AF. (n=3).	Johansson (2014); Pusser (2005); Sudlow (1997).
Poor compliance. (n=3).	DeWilde (2006); Dinh (2007); Pusser (2005).
Seizure. (n=3).	Boulanger (2006); Holt (2012); Pusser (2005).
Co-morbid illness. (n=2).	O'Brien (2014); Sudlow (1997).
GI malignancy. (n=2).	Holt (2012); Pusser (2005).
Genetic factors. (n=2).	Brandes (2013); Willey (2018).
Hepatitis. (n=2).	Boulanger (2006); Mazzaglia (2011).
Proliferative retinopathy. (n=2).	Adderley (2017); Isaew (2016).
Ulcer healing drugs. (n=2).	DeWilde (2006); Holt (2012).
Absolute & relative CIS. (n=1).	Johansson (2014).
BMI< 20. (n=1).	Viscogliosi (2017).
CHA_2DS_2VASC 0/1 (female). (n=1).	Johansson (2014).
Duel OAC/APL. (n=1).	O'Brien (2014).
Frailty. (n=1).	O'Brien (2014).
Inability to walk/being in a wheelchair. (n=1).	Viscogliosi (2017).
Injuries or fractures. (n=1).	Mazzaglia (2011).
local routine. (n=1).	Dinh (2007).
Occupational hazards. (n=1).	O'Brien (2014).
OAC for other indications. (n=1).	Sudlow (1997).
Post DCCV successful. (n=1).	Sudlow (1997).
Reversible and non-reversible CIS. (n=1).	Sudlow (1997)
Syncope. (n=1).	Pusser (2005).

Appendix 10. Stroke-risk factors used.

Stroke risk factor.	Papers who employ stroke risk factor measure.
CHA_2DS_2VASC. (n=28).	Abdul-Rahim (2013); Adderley (2017); Adderley (2018); Apenteng (2017); Ashburner (2017); Bahri (2015); Brandes (2013); Clua-Espuny (2013);Das (2015); Ding (2017); Dreishulte (2014); Forslund (2013); Hanon (2014); Holt (2012); Isaew (2016); Johansson (2014) Lacoin (2017), Mazurek (2017); Meniertz (2011); O'Brien (2014); Robson (2014); Samsa (2000); Scowcroft (2012); Schwill (2018); Shantasila (2015); Tomlin (2017); Valentinis (2014); Willey (2018).
$CHADS_2$. (n=26).	AbuDagga (2014); Abdul-Rahim (2013); Adderley (2017); Brandes (2013); Carlsson (2013); Cowan (2012); DeWilde (2006); Dinh (2007); Dreishulte (2014); Ewen (2012); Forslund (2013); Gallagher (2008); Hanon (2014); Isaew (2016); Jacobs (2009); Kassianos (2013); Khan (2014); Lee (2011); Mashal (2011); Mazzaglia (2010); Meniertz (2011); O'Brien (2014); Robson (2014); Robson (2018); Schwill (2018); Scowcroft (2012).
Previous stroke/TIA. (n=13).	Blich (2014); Boulanger (2006); Deplanque (2004); Jain (2017); Oswald (1999); Pusser (2005); Ruigómez (2002); Sabouret (2015); Simpson (2005); Smith (1999); Sudlow (1997); Sudlow (1998); Whitford (2000).
Diabetes. (n=11).	Blich (2014); Boulanger (2006); Deplanque (2004); Oswald (1999); Pusser (2005); Ruigómez (2002); Smith (1999); Sabouret (2015); Sudlow (1997); Sudlow (1998); Whitford (2000).
Hypertension. (n=11).	Blich (2014); Boulanger (2006); Deplanque (2004); Oswald (1999); Pusser (2005); Ruigómez (2002); Sabouret (2015); Smith (1999); Sudlow (1997); Sudlow (1998); Whitford (2000).
Congested heart failure. (n=10).	Blich (2014); Boulanger (2006); Deplanque (2004); Oswald (1999); Pusser (2005); Ruigómez (2002); Sabouret (2015); Smith (1999); Sudlow (1998); Whitford (2000).
Not stated. (n=7).	Ceresne (2002); FALSTAF study group (2007); Leung (2017); Murphy (2007); Murphy (2018); Viscogliosi (2017); White (1999).
Age > 75. (n=4).	Deplanque (2004); Pusser (2005); Ruigómez (2002); Whitford (2000).
Age >65* Age> 70.** (n=2).	*Sudlow (1997); **Sabouret (2015).
Enlarged atrium. (n=2).	Sudlow (1998); Smith (1999).
Age > 60. (n=1).	Oswald (1999).
American College of Chest Physicians (Albers 2001). (n=1).	Anderson (2005).
Female> 75. (n=1).	Sudlow (1998).
MI/CVD. (n=1).	Oswald (1999).

Appendix 11. OAC used over time as per stroke-risk scoring.

CHA_2DS_2VASC risk-scores over time in anticoagulated and non-anticoagulated patients with atrial fibrillation (Ashburner et al. 2017).						
Year.	Mean CHA_2DS_2VASC risk-score.*			CHA_2DS_2VASC risk-score = ≥4.*		
	All Patients.	Anticoagulated.	Not Anticoagulated.	All Patients.	Anticoagulated.	Not Anticoagulated.
2010	3.41	3.72	3.01	47.5%	53.1%	40.0%
2011	3.47	3.80	3.05	48.8%	55.4%	40.4%
2012	3.74	4.11	3.26	54.7%	62.4%	44.6%
2013	3.78	4.19	3.26	55.5%	64.2%	44.8%
2014	3.83	4.21	3.33	56.4%	64.3%	46.0%
2015	3.82	4.19	3.33	55.9%	63.8%	45.4%

OAC use between 2001-2004 and 2007-2010. (Ding et al.2017).					
	Use of anticoagulant drugs.				
Risk-category.	Year 2001–2004.		Year 2007–2010.		
	n/a	% (95% CI)	n/a	% (95% CI)	
Total (age ≥ 66 years).	313/71	22.7 (18.0–27.3)	308/101	32.8 (27.5–38.0)	*p* 0.005
$CHADS_2$ risk-score: Low-risk (0).	10/0	0.0 (0.0–0.0)	5/1	20.0 (0.0–55.1)	-
Intermediate- risk (1).	48/8	16.7 (6.1–27.2)	37/9	24.3 (10.5–38.1)	*p* 0.313
High-risk (2–6).	255/63	24.7 (19.4–30.0)	266/91	34.2 (28.5–39.9)	*p* 0.085
CHA_2DS_2VASC risk-score.					
Low-risk (0).	0/0	0.0 (0.0–0.0)	0/0	0.0 (0.0–0.0)	-
Intermediate-risk (1).	4/0	0.0 (0.0–0.0)	3/0	0.0 (0.0–0.0)	-
High-risk (2–9).	309/71	23.0 (18.4–28.1)	305/101	33.1 (27.9–38.7)	*p* 0.008
Incomplete HASBLED Score.					
Low-risk (0–2).	75/24	32.0 (21.4–42.6)	59/31	52.5 (39.8–65.3)	*p* 0.004
High-risk (3–8).	238/47	19.7 (14.7–24.8)	249/70	28.1 (22.5–33.7)	*p* 0.073
A n/a indicates number of patients with AF/number of patients who used drugs. b Adjusted for age, sex, and education.					

OAC and APL used between 1995 and 2014 (Jain et al. 2018).								
	All OAC used. n (%)	Type OAC. n (%)	Total OAC. n (%)	Antiplatelet. n (%)	OAC + APL. n (%)	None. n (%)		
	147 (19)	Warfarin Dabigatran Unspecified	135 (92) 1 11 (7)	346 (44)	18 (2)	(35)		
		1995–1998.	1999–2002.	2003-2006.	2007–2010.	2011–2014.	Trend.	
High-risk.	OAC use.	(9.3)	(14.5)	(19)	(25)	(30.4)	Increase.	*p*<0.001
	APL.	(43.0)	(43)	(62.4)	(53.3)	(48)	Increase.	ns
low-moderate-risk.	OAC use.	(17)	(15)	(21)	(25)	(13)	Mixed.	*p* 0.669
	APL.	(21)	(35)	(54.7)	(40)	(32)	Mixed.	*p* 0.027

The proportion of patients at risk of stroke treated with anticoagulants between the years 2000 and 2016 (Adderley et al. 2018).						
	2000		**2016**			**Trend.**
AF prescribed anticoagulants.	34.3%	(95% CI 33.7% to 34.9%)	71.5%	(95% CI 71.1% to 71.8%)	*p*<0.001	Increase.
Prescribed antiplatelet drugs only.	32.4%	(95% CI 31.8% to 33.0%)	12.2%	(95% CI 12.0% to 12.5%)	*p*<0.001	Decrease.
Receiving no medication.	33.3%	(95% CI 32.7% to 33.9%)	16.3%	(95% CI 16.0% to 16.6%)	*p*<0.001	Decrease.
The case-mix of patients with AF.						
The proportion of patients with CHA_2DS_2VASC risk-score ≥2.	86.9%	(95% CI 86.4% to 87.3%)	90.3%	(95% CI 90.1% to 90.6%)		Increase.
Proportion of patients with AF aged ≥75 years.	56.0%		58.1%;		*p*<0.001	Increase.
OAC USE trends.						
High-risk :(CHA_2DS_2VASC ≥2), the proportion prescribed anticoagulants.	35.4%	(95% CI 34.7% to 36.1%)	75.5%	(95% CI 75.1% to 75.8%)	*p*<0.001	Increase.
Moderate risk: (CHA_2DS_2VASC =1 and male) proportion prescribed anticoagulants.	32.8%	(95% CI 30.5% to 35.2%)	47.1%	(95% CI 45.4% to 48.7%)	*p*<0.001	Increase.
Low-risk: (CHA_2DS_2VASC =0 for males or 1 for females) proportion prescribed anticoagulants.	19.9%	(95% CI 17.8% to 22.2%)	9.7%	(95% CI 8.4% to 11.1%)	*p*<0.001	Decreased.
High-risk: APL only.	35%		12.3%	(95% CI 12.1% to 12.6%)	*p*<0.001	Decreased.
Moderate-risk: APL only.	20.7%	(95% CI 18.8% to 22.8%)	14.9%	(95% CI 13.8% to 16.1%)	*p*<0.001	Decreased.
Low-risk: APL only.	9.2%	(95% CI 7.8% to 10.9%)	4.9%	(95% CI 4.0% to 5.9%)	*p*<0.001	Decreased.
High-risk: neither OAC/APL.	29.6%	(95% CI 29.0% to 30.3%)	12.2%	(95% CI 11.9% to 12.5%)	*p*<0.001	Decreased.
Moderate-risk: neither OAC/APL.	46.5%	(95% CI 44.0% to 48.9%)	38.0%	(95% CI 36.5% to 39.6%)	*p*<0.001	Decreased.
Low-risk: Neither OAC/APL.	70.9%	(95% CI 68.3% to 73.3%)	85.5%	(95% CI 83.8% to 87.0%)	*p* <0.001	Increased.
Defining stroke-risk by $CHADS_2$ risk-score.						
High-risk treated	37.0%	(95% CI 36.2% to 37.9%)	78.3%	(95% CI 77.9% to 78.7%)	*p*<0.001	Increased.
Moderate risk ($CHADS_2$ =1), with the proportion treated.	32.2%	(95% CI 31.1% to 33.4%)	63.4%	(95% CI 62.6% to 64.2%)	*p*<0.001	Increased.
Low-risk ($CHADS_2$ =0) treated with OAC.	25.4%	(95% CI 23.7% to 27.1%)	25.2%	(95% CI 23.8% to 26.7%)		No change.
Ineligible patients include those with contraindications PX OAC.	28.1%	(95% CI 26.3% to 29.9%)	47.5%	(95% CI 46.1 to 48.9)	*p*<0.001	Increased.
The proportion of anticoagulated patients with AF prescribed warfarin.	99.3%		64.0%			Decreased.
Prescribed NOACs.	-		38.1%			Increased.

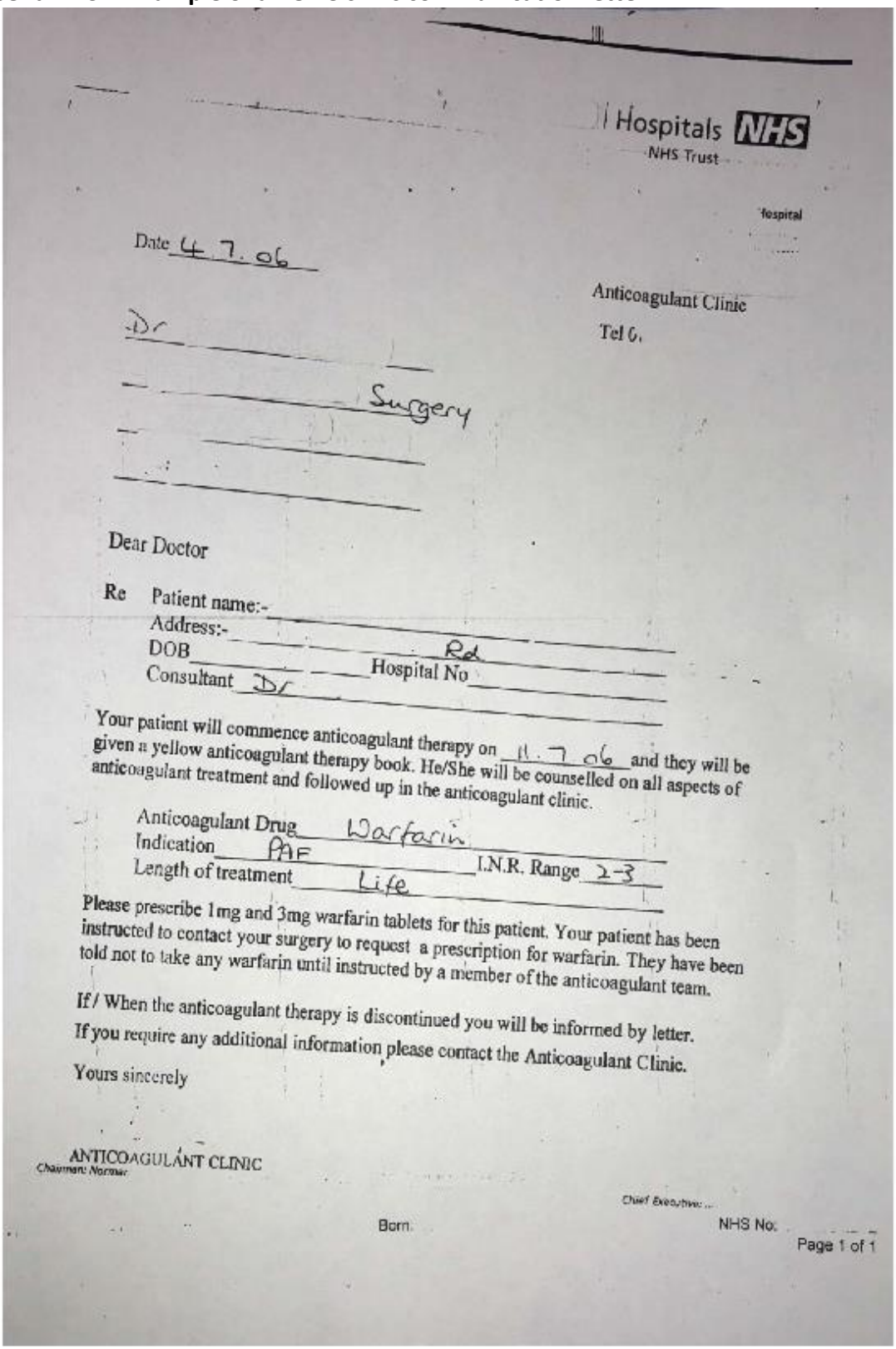
Appendix 12. Normalization Process Theory Interview framework.

Lea's Interpretation.	Theoretical elements.	Key information linked to Theory.	Possible data coding prompts.	Possible questions.	Rationale. 2. To explore the factors involved in decision-making about OAC prescribing in primary-care, and explain how these relate to under-usage
What is the work?	**Coherence:** The **sense making** work that people do when they are faced with using a new set of practices				
	Differentiation.	Perceived difference between old and new systems of work, that have consequences for how people operate in practice	Can people easily describe the new practice and appreciate how it differs from what they were doing before, or what others are doing?	Before you started managing your own warfarin-dosing for AF patients (LES), and before the changes to the AF QOF Q How, where and by whom, were decisions about stroke prevention in AF patients made? Q: What was your role in this then, and how did you think it may have changed by doing these new roles?	**What is the work** is concerned with the situation before the changes? The situation as defined before the changes identified in the REG doc. This is not to say that these changes will influence the underuse per-say but that the changes will change the way general-practice approaches this care. Therefore, I include these changes as a high tide mark from which to base the before & after of approaches to OAC management in the primary care setting.
	Communal Specification.	Collective agreement about the purpose and function of how new OAC management and decision-making should/did work	Is there evidence of variation in understanding of OAC aims, objectives, processes, or expected outcomes? Is there agreement at an organisational level? What factors influence agreement?	Q: Did you all agree for the need to start managing your own OAC decisions? Q: How did you and your colleagues come to agree on the need for change in this area? Q: What were you all hoping to achieve by undertaking this new approach to OAC care?	
	Individual. Specification.	Collective agreement about the purpose and function of how OAC decision-making and management systems should work	Can people easily make sense of how OAC changes will work in their area and what their new tasks and responsibilities are?	Q: Did you have a clear understanding of your role in these changes to your practice? Q: How did you see the new changes working in practice?	
	Internalization.	Perceptions of the value, benefits, importance of OAC decision-making and management in practice	What criteria are used to evaluate the value, benefits importance of the new practice? Is their variation in effort/input?	In considering undertaking the LES and the proposed changes to the QOF: Q: Is undertaking this new role good for your practice and your patients? Q: How important/practical do you feel stroke prevention in AF patients is in your patients' group and is there anything that you perceived to be negative or harmful to either your practice or patients from being involved in this new area of care?	

	Theoretical elements.	Key information linked to theory.	Possible data coding prompts.	Possible questions.	Rationale.
Who does the work?	**Cognitive Participation:** the **relational work** that people do to build and sustain a new practice				
	Initiation.	Key individuals drive OAC decision-making and management forward	Key stakeholders (individuals, groups, business functions, organizational; systems) are willing to get involved	Q: Which people are key to the success or otherwise of this change of practice and why? Q: Are there any people or factors that you feel may affect the success or otherwise of this practice and why?	In this section, I expect the staff to discuss how the ideas and initial suggestion that we were going to undertake this role happened. First there were discussions, disagreements and many different attitudes and beliefs about how safe it was, the pressures of extra responsibility on existing caseloads, then there were opportunities for better patient contact and care, educational opportunities.
	Enrolment.	People agree that OAC decision-making and management should be part of their work	Do people agree that they should be involved and that they can contribute? How is formal agreement negotiated?	Q: How did you become involved in OAC practice and how did you feel about becoming involved? Q: what were your views about AF, stroke-preventions and OAC and Were there any factors that worried you about this area of work? Q: Were there any factors that you encouraged you to be involved?	
	Legitimation.	People participate in OAC management, decision-making systems governance procedures	Are organizations and groups organising themselves to undertake OAC decisions-making and management e.g. reimbursement, legal, work allocation issues?	Q: How difficult or easy has it been for you and the others – do you think - to organise the changes to your work around OAC management and decision-making? Q: What steps have you taken or have been taken to organise the changes?	
	Activation.	People work together to develop new work processes.	Are people working together to build the policies and procedures needed to introduce and sustain the new practice?	Q: Have there been any problems implementing these new changes of practice and how are you involved in developing solutions to these? Q: What factors are in place to help organise and maintain the OAC care given?	
	Theoretical elements.	**Key information linked to theory.**	**Possible data coding prompts.**	**Possible questions.**	**Rationale.**
	Collective action: The **operational work** that people do to enact a new practice.				
	Interactional workability.	**Congruence** (Co-operation, legitimacy, Conduct) **Disposal** (Goals, meanings, Outcomes). Staff and patients can perform the tasks required by OAC decision-making and management.	Can people do what is required? I.e. is there enough flexibility in the appointment system? What time is given to manage OAC?	Q: What systems are in place and how much priority is given to managing OAC in the practice? Q: What priority is given to exploring unmet stroke-risk and examining OAC needs since these changes.	
	Relational integration.	**Accountability** (Validity, Expertise, Dispersion) **Confidence** (Credibility, Utility, Authority) Staff trust each	Communication is facilitated. People are confident in themselves and others' abilities.	Q: How and what evidence informs your practice in this OAC and do you feel that you have up to date knowledge? Q: Do you feel confidence in undertaking this role? Q: Do you have any confidence or concerns about those around you	

How does the work get done?		other's work and expertise in OAC decision-making and management.		undertaking this role? Q: How is this OAC decision-making and practice discussed and shared in-house? Q: What choice did you have in undertaking this new role, what choice did others have?	In this section I expect discussion will focus upon what actual training, IT systems, and the formulation of SOPs and policy for practice developed, all staff were involved in this.
	Skill set workability.	**Allocation** (Distribution, Definition, Surveillance) **Performance** (Boundaries, Autonomy, Quality) The work involved in OAC decision-making and management is appropriately allocated.	Who should do this? Do the people have the right skills and training to do OAC decision-making and management?	Q: What roles do other people do around you in relation to OAC decision-making and what skills do they have? Q: Do you use any specific tools to help OAC decisions or organize your OAC practice, how do you feel about these?	
	Contextual integration.	**Execution** (Resourcing, Power, Evaluation) **Realization** (Risk - to existing systems, Action - how the organization value/supports the OAC decision-making and management system into practice adequately enacted.	Is the new practice supported in terms of adequate resources e.g. leadership, training, technical support, resources?	Q: How have you felt supported in undertaking decisions about OAC in AF patients? Q: What factors have helped enable this support? Q: What factors might have been more useful or that are still required? Q: How have you managed and with what resources?	
	Theoretical elements.	**Key information linked to theory.**	**Possible data coding prompts.**	**Possible questions.**	**Rationale.**
How is the work understood?	**Reflexive Monitoring**: The **appraisal work** that people do to access and understand how a new practice affects them and others.				
	Systemization.	People collect information about the impact of OAC decision-making and management.	How is OAC decision-making and management being evaluated? What data sources are being used?	Q: How is OAC decision-making and management being evaluated? Q: What data sources are being used?	I expect this section will focus on the progress made, how confidence had grown from the initial setting up and recruitment of stable AF patients on warfarin to actively screening the general older population for AF. Commencement of OAC, systems to increase early detection, risk assessment adoption, refinement of the policy and the introduction of the new OAC drugs and their impact maybe on future decisions about care.
	Communal appraisal.	People collectively evaluate OAC decision-making and management as worthwhile.	What criteria are used collectively to evaluate the worth of OAC decision-making and management?	Q: How do you and your colleagues decide how useful OAC involvement has been together? Q: What factors do you feel the group might think would affect both the effectiveness and your desire to continue the practice? Q: What things might stop you from carrying on with this practice?	
	Individual appraisal.	Individuals evaluate OAC decision-making and management as worthwhile	Do individuals affected by or involved with the intervention think it's worth doing?	Q: In your experience, have you found that decisions about OAC now, are worth doing? Q: How do you feel your patients have responded to you being responsible for decisions about OAC?	
	Reconfiguration.	People modify their work in response to their evaluation of OAC decision-making and management.	What sort of changes are people making based on their experiences with the implementation or use of OAC?	Q: How has being involved in decisions about OAC and its management affected your practice? Q: Have you done anything different now since being involved? Q: What do you feel needs to change in the future, if it is to improve or continue?	

Appendix 13. Example of an OAC clinic communication letter.



Hospitals NHS
NHS Trust

Hospital

Date 4.7.06

Anticoagulant Clinic
Tel 0.

Dr

Surgery

Dear Doctor

Re Patient name:-
Address:- Rd
DOB Hospital No
Consultant Dr

Your patient will commence anticoagulant therapy on 11.7.06 and they will be given a yellow anticoagulant therapy book. He/She will be counselled on all aspects of anticoagulant treatment and followed up in the anticoagulant clinic.

Anticoagulant Drug Warfarin
Indication AF I.N.R. Range 2-3
Length of treatment Life

Please prescribe 1mg and 3mg warfarin tablets for this patient. Your patient has been instructed to contact your surgery to request a prescription for warfarin. They have been told not to take any warfarin until instructed by a member of the anticoagulant team.

If/ When the anticoagulant therapy is discontinued you will be informed by letter.

If you require any additional information please contact the Anticoagulant Clinic.

Yours sincerely

ANTICOAGULANT CLINIC
Chairman: Norman

Chief Executive:

Born

NHS No.

Page 1 of 1

Appendix 14. Example of data extraction sheet.

Electronic AF data collection sheet V11. 26.03.13.

Date records accessed.	
ID #	
Gender.	
Age at mapping.	

Co-morbidity.	Hypertension.	Cardiac failure.	Diabetes.	Value Disease.	Stroke.	Thyroid.	TIA.	COPD.	Cancer.	MI.	Falls.	Familial hypercholesterolemia.	PAD.	VTE.

Evidence for contraindication.	Yes.	No.	What?	Not indicated.		Other.	
				Date:			

Documented CIS.	Y	N	Bleeding-risk.	Allergy.	Uncontrolled BP.	Labile INRs.	Abnormal renal.	Abnormal liver.	Anaemia.	Alcohol.	Lacks capacity.	Social reasons.	>3 meds.	Falls.	Pro-bleeding drugs.	Other.
Date:																

Initial Investigations.									
	Date First documented:		Where/by who?	GP.	WIC.	Community clinic.	AED.	Outpatients.	Ward.
	Reason for presentation (E.G flu clinic).	Pulse-check		Regular.	Irregular.	Symptomatic.	Asymptomatic.		
		Y	N						

Method of diagnosis documented.	Yes?	No?	Date:	12 lead only.		Holter device.		Other.
				Yes.	No.	Yes.	No.	

AF Diagnosis	First documented		GP.	Other.
Age at diagnosis				

Assumed $CHADS_2$ at diagnosis		**Assumed** CHA_2DS_2VASC at diagnosis -		**Pulse recorded before AF diagnosed regular?**	**Rhythm NOT STATED.**	Pulse recorded before AF diagnosed irregular?	BP (no pulse) recorded pre-AF diagnosis.

ID #				
AF category.	Paroxysmal.	Not stated.	Permanent.	

Urgency.		Urgent.		Emergency symptoms?			Emergency other?			Non-urgent.		Symptoms?		No symptoms.					
				Yes.	No.	What?	Yes.	No.	What?			Which?		How?					
Intervention.		Cardioversion.					Ablation.					Angioplasty.				Other.			
		Yes.		No.		Date:	Yes.		No.		Date:	Yes.		No.	Date:	What?		Date:	
Stroke-risk discussed?		Yes.	No.	Don't know.		GP?	Nurse (GP).		Cardiologist.			Haematologist.			Nurse (hosp).	When?			
Stroke-risk score.		Documented $CHADS_2$ risk-score?								Documented CHA_2DS_2VASC?									
		Yes.		No.		Date:			Score:	Yes.		No.		Date:				Score:	
Stroke-risk Discussed?																			
Yes.	**No.**	Scored on:		CCF/LVSD.						Scored on:				CCF/LVSD.					
				Hypertension/untreated bp > 140/90.										Hypertension/Untreated bp > 140/90.					
				Age> 75.										Age> 75.					
				Diabetic.										Diabetic.					
				Stroke/TIA.										Prior stroke/TIA/Thromboembolism.					
														Vascular disease (PAD, MI, aortic plaque).					
														Age 65-74years.					
														Sex category (female).					

ID #												
Bleeding-risk	HASBLED				Other bleeding-risk tool				Which?			
	Yes	No	Date	Score	Yes	No	Date	Score				
	Scored on				Scored on							
Abnormal renal function			Hypertension									
Abnormal liver function			Stroke									
Bleeding			Labile INRs									
Elderly (>65)			Drug therapy									
Alcohol (8 units/week)												

Management Decision to treat made by:		Haematology.		Cardiology.		GP.		Other.	
Age at decision:		Date:		Date:		Date:		Date:	

OAC management Decision outcome: Date:	Nothing.	Aspirin.	Clexane.	Warfarin.	New agent.	Offered but declined.	Lack persistence.	Warfarin stopped.

AF drug treatments.	Rate limiting only.	Which.	Rhythm limiting only.	Which.	Both.	Which.

OAC managed by/venue.	GP in house.		Secondary care blood & dose @ GP.	Secondary care blood & dose @ primary care centre.	Secondary care blood & dose @ Hospital clinic.	Self-managed.
	TTIR:					

ID #	
Summary:	

Timeline:

Pre-existing state:

Co-morbidity:	**Drugs:**	**Added risk:**		
Event:	**Date:**	**Timing 1(days):**	**Timing 2 (days):**	**Timing 3 (days):**

Appendix 15. AF patient coded presentation and management pathways.

GP Urgent.										
	M1	GP/SX	Urgent referral	AED △	Cardiology OPD	TX				
	M2	GP/SX	Urgent referral	AED △	TX					
	M3	GP/SX	Urgent referral	AED △	Ward	TX				
	M3a	GP/SX	Urgent referral	AED △	TX	Cardiology OPD	TX			
	M10	GP/SX	GP urgent referral	AED/△	TX	Ward	TX	OPD	TX	
	GP1b	GP/SX	ECG In house	GP/△ urgent referral	AED	TX	Ward	TX		
	GP1c	GP/SX	ECG In house	GP/△ urgent referral	MIU	TX	OPD	TX		
	GP1e*	GP/SX	ECG / OPD	GP/△	GP urgent referral	AED / sx	TX			
GP non-urgent.										
	GP1	GP/SX	ECG In house	GP/△	TX					
	GP1a	GP/SX	ECG In house	GP/△	TX	GP refer Cardiology	Cardiology	TX		
	GP1b*	GP/SX	In house ECG	GP/△	GP / Cardiology	TX	GP refers OAC			
	GP1d	GP/SX	ECG / OPD	GP/△	TX	GP refer Cardiology	M3	TX		
	GP1e	GP/SX	ECG in-house	GP/△	GP refers OPD	OPD	TX			
	GP2	GP/SX	ECG/OPD	GP refer Cardiology	Cardiology refers GP	TX	GP refers OAC	TX		
	GP3	GP/SX	GP Refer Ix/OPD	OPD/△	TX					
	GP3a	GP/SX	GP Refer Ix/OPD	GP/△	GP refers Cardiology	Cardiology	TX			
	GP3b	GP/SX	GP refers Ix/OPD	OPD refers GP	GP/△	TX				
	GP3c	GP/SX	ECG/OPD	Ix/OPD	Cardiology/△	TX				
	GP3d	GP/SX	GP refers OPD/IX	OPD/IX/△	TX	OPD refers GP	GP	TX		
	GP5a	GP/SX	ECG/OPD	GP/△	TX	GP refer Cardiology	Cardiology	TX		
	GP5b	GP/ SX	ECG/OPD	GP/△	TX	GP refer Cardiology	Cardiology	TX	Cardiology refers GP	GP refers OAC
	GP5c	GP/ SX	In house ECG	GP refer Cardiology	Cardiology/△		Cardiology refers GP	GP refers OAC		

	GP7	GP/SX	ECG/OPD	GP/△	GP Refers Cardiology	Cardiology	TX			
	GP10	GP/~~SX~~	ECG/OPD	GP/△	GP Refers Cardiology	Cardiology	TX			
	GP10a	GP /~~SX~~	ECG/OPD	GP/△	TX					
	GP11	GP/SX	GP refers OPD	OPD/△	OPD refers GP	GP refer OAC	TX			
	GP11*	GP/SX	ECG/OPD	GP/△	TX					
	GP12	GP refers cardiology	Cardiology	Tx	Cardiology refer GP	GP refers OAC				
	GP12a	GP/SX	GP refers Cardiology	Cardiology/△	TX					
	GP13	GP/~~SX~~	ECG In house	GP refer Cardiology	Cardiology/△	TX				
	GP13a	GP/~~SX~~	ECG/OPD	GP/△	GP Refers Cardiology	Cardiology	TX	Cardiology refers GP	GP refers OAC	
	GP14	GP	TX							
	GP15	GP/SX	ECG/OPD	GP/Cardiology	TX	GP initiates OAC				
GP non-urgent > Urgent.										
	GP4	GP/SX	ECG / OPD	OPD urgent referral	AED/△	Ward	TX			
	GP4a	GP/SX	ECG/OPD	OPD urgent referral	AED/△	Ward	TX	OPD	TX	
	GP4b	GP/SX	TX	ECG/OPD	Urgent referral	AED/△	Ward	TX		
OPD.										
	M4	OPD/△	Urgent referral	Ward	TX					
	M7	OPD/△	TX							
	M7a	OPD/△	OPD refers OAC	TX						
	M8	OPD/△	Refers GP	TX	GP Refers Cardiology	Cardiology	TX			
	M8a	OPD/△	OPD refers GP	GP	TX	GP initiates OAC	GP refers Cardiology	TX		
	M8b	OPD/△	OPD refers GP	GP refer Cardiology	Cardiology	TX				
	M8c	OPD/△	OPD refer GP	GP	TX					
	M9	OPD/△	TX	OPD refers Cardiology	Cardiology	TX				

AED.									
	A1	AED/SX	△	TX					
	A2	AED/SX	△	Ward	TX				
	A3	AED/SX	△	OPD	TX				
	A3a	AED/SX	△	OPD	TX	refers GP	GP	TX	
	A3b	AED/SX	△	GP	TX				
	A4	AED/SX	△	TX	OPD	TX			
	A4a	AED/SX	△	TX	Ward	OPD	TX		
	A5	AED/SX	△	Ward	TX	Ward refers GP	GP refers Cardiology	Cardiology	TX
	A6	AED/SX	AED refers GP	GP refer Cardiology	Cardiology/△	TX			
Ward									
	M5	Ward/SX	Refer GP	GP refer Cardiology	Cardiology OPD	TX			
	M6	Ward/△	TX						
	M6a	Ward/ △	TX	AED/SX/△	TX				
	M6a*	Ward/SX/△	ward refers OPD	OPD	TX				
Walk-in centre									
	M1a	WIC/SX	Urgent referral	AED/△	Ward	TX			
	M1b	WIC/SX/△	GP refers Cardiology	Cardiology	TX				
Missing data									
	CO	Read-code ONLY							

KEY:

△ = Diagnosis.

Sx = Symptoms.

TX = treatment decision.

Appendix 16: Analysis of antithrombotics use.

OAC use compared to age at mapping and age at diagnosis.						
Age at Mapping.	Taking OAC.	Not taking OAC.		Age at diagnosis.	Taking OAC.	Not taking OAC.
Included (n):	154	143		Included (n)	146	135
Mean age:	74.04	74.40		Mean age	69.32	69.73
SD:	9.59	12.90		SD	10.67	13.40
t -0.27	*df* 295	*p* 0.78		*t* -0.29	*df* 279	*p* 0.78
95%CI of the difference: -2.94 to 2.22				95%CI of the difference: -3.25 to 2.42		

GP use of antithrombotics compared to GP referrals.							
GP-referral to:	**Total (%)**	**GP decides drug.**	**n (%)**	χ^2	***p***	**Odd ratio (no/yes)**	**95%CI**
Cardiology.	54 (100)	Aspirin.	36 (66.7)	4.94	0.03	2.48	1.11 to 5.55
		Warfarin.	20 (37.0)	0.12	0.73	0.87	0.39 to 1.94
		Nothing.	1 (1.9)	1.36	0.24	0.28	0.03 to 2.76
OAC clinic.	21 (100)	Aspirin.	8 (38.1)	3.63	0.06	0.39	0.15 to 1.05
		Warfarin.	18 (85.7)	24.81	6.32	16.86	4.50 to 63.09
		Nothing.	0 (0)	1.09	0.30	0.95	0.90 to 1.00
ECG.	56 (100)	Aspirin.	38 (67.9)	6.12	0.01	2.78	1.23 to 6.30
		Warfarin.	24 (42.9)	1.27	0.26	1.61	0.70 to 3.67
		Nothing.	2 (3.6)	0.06	0.81	0.78	0.11 to 5.76
Another service.	29 (100)	Aspirin.	15 (51.7)	0.46	0.50	0.74	0.31 to 1.76
		Warfarin.	10 (34.5)	0.21	0.64	0.81	0.33 to 1.99
		Nothing.	1 (3.6)	0.02	0.98	0.85	0.09 to 8.55

OAC use ever versus gender and age under and over 75.							
Factor.	Total. n (%)	Males.	Females.	χ^2	*p*	OR	95%CI for OR
		n (%)	n (%)	1.96	0.16	0.71	0.44 to 1.15
OAC ever.	198 (66.7)	113 (70.2)	85 (62.5)				
		Age < 75 years.	Age > 75 years.	χ^2	*p*	OR	95%CI for OR
		n (%)	n (%)	0.17	0.68	0.90	0.56 to 1.47
		93 (68)	105 (65.6)				

Antithrombotic use by $CHADS_2$ high-risk score.						
$CHADS_2$ risk-score = greater than 2.						Total (%)
	n (%)	χ^2	*P*	OR	95%CI for OR	213 (100)
Treated with OAC. n (%)	105 (70.5)	0.23	0.63	0.88	0.53 to 1.47	
Treated with APL. n (%)	88 (41.3)	2.74	0.10	1.57	0.92 to 2.69	
Degrees of freedom. (*df*) 1						

Antithrombic treatment by CHA_2DS_2VASC high-risk score.						
CHA_2DS_2VASC risk-score greater than 1 and not female						Total (%)
	n (%)	χ^2	*p*	OR	95%CI for OR	284 (100)
Treated with OAC. n (%)	110 (51.6)	4.51	0.03	3.78	1.02 to 14.04	
Treated with APL. n (%)	112 (39.4)	3.04	0.08	3.58	0.78 to 16.46	
Degrees of freedom. (*df*) 1						