Executive Summary

Catheter ablation is a minimally invasive procedure performed by Cardiac electrophysiology sub-specialised Cardiologists for the treatment of many cardiac arrhythmias. It is a mature but continually evolving technology with clear indications for use as first-line treatment in certain defined population subgroups. Its role in the treatment of atrial fibrillation (AF) is less clear, but as AF is the commonest adult arrhythmia the potential increase in demand is significant.

Atrial fibrillation affects 2.0% of the New Zealand population. It is more common in Maori, in whom it occurs at a younger age. AF is associated with a 2-fold increase in overall mortality, as well as increased risk of stroke, dementia, and heart failure. Standard treatment involves the use of medications to control symptoms and reduce the rates of long-term complications.

Cardiac catheter ablation (CA) in atrial fibrillation avoids the complications and side effects of anti-arrhythmic medication use. It offers possible long-term “cure” of AF, and is associated with significantly improved rates of freedom from AF when compared with medication. The data on long-term outcomes is less robust and there have to-date been no published randomised controlled trials looking at its effect on rates of stroke, heart failure and mortality. Of concern has been the 4-6% complication rate with serious adverse effects at 2-3%, but these rates reduce as experience with the technology improves.

Cost-effectiveness analyses of CA in AF have had differing conclusions, from being cost-saving to being cost-inefficient. Catheter ablation’s affordability is limited by significant capital expenditure and the high up-front costs of procedures. Basic modelling in the New Zealand context suggests that there may be a group of patients in whom catheter ablation is highly cost-effective.

New Zealand has a limited supply of cardiac electrophysiology services and there is the potential for significantly increased future demand as the population ages, AF becomes more prevalent and the scope of EP grows. International data suggest New Zealand’s cardiac electrophysiology
services are growing significantly slower than Europe and North America. The sustainability of the service requires extensive sector engagement, workforce analysis and retention, planned capital investment and appropriate selection of the intervention population.

**Purpose**

The purpose of this report is to provide information to stakeholders, including clinicians, health planners, funders and policy makers on the use of CA in AF, and as a basis for further discussion. It includes:

- Background on the nature and impact of AF
- Explanation of the differing treatment strategies employed in its treatment
- A summary the current literature on catheter ablation for AF
- A description of its current and potential future use in New Zealand.

**Catheter Ablation for Arrhythmia**

Electrophysiology is a sub-speciality of Cardiology concerned with diseases causing abnormal electrical conduction in the heart (arrhythmia). It is a complex and evolving area, with interventions including, but not exclusively, catheter ablation, medical therapy, pacemaker and implantable cardioverter-defibrillator insertion.

Catheter ablation involves the passing of a catheter through the blood vessels to the heart. There the abnormal electrical signals are found, mapped and then destroyed or electrically isolated by damaging (ablating) heart muscle. The technique has revolutionised the treatment of many arrhythmias and offers a long term cure after a single procedure in some.\(^1,2\) It has become the standard of care for atrioventricular re-entrant tachycardia (AVRT), atrioventricular nodal re-entrant tachycardia (AVNRT) and some types of atrial flutter.\(^1\)

While it is undoubtedly efficacious and cost-effective in these patient groups,\(^3,4\) its role in the treatment of atrial fibrillation is more controversial. The technology is both expensive and evolving with the potential for large increase in scope and demand on resources.

**Atrial Fibrillation**

Atrial fibrillation (AF) is the commonest sustained cardiac arrhythmia\(^5\), and has a large associated societal, economic and health burden. A 2010 PricewaterhouseCoopers report estimated that the annual cost of AF to Australia was AUS$1.25 billion\(^6\). AF’s incidence rises with age and the prevalence of AF will grow as the population ages. AF, therefore, represents a potential future epidemic\(^7\) and its cost-effective management an important challenge.
Background

Atrial fibrillation is characterised by loss of the normal electrical rhythm of the heart (sinus rhythm), which is replaced by chaotic contraction of the atria (upper chambers of the heart) and results in an irregular, often rapid, heartbeat. It is associated with an approximate 2-fold increase in cardiac and overall mortality.\(^8\)\(^-\)\(^10\) The prevalence of atrial fibrillation based on international data is 0.4 - 2%.\(^9\)\(^,\)\(^11\)

Atrial fibrillation may be asymptomatic (“silent AF”), but more frequently presents with palpitations, dizziness, reduced exercise tolerance, breathlessness, collapse or chest discomfort. More importantly, it is associated with an increased risk of cardioembolic complications (most notably stroke), dementia, heart failure and death\(^12\). The goals of treatment are the reduction of symptomatic episodes (and hospitalisations), prevention of cardiac remodelling (including heart failure), cardioembolic stroke and death.

Atrial fibrillation increases the risk of stroke between 2- and 7-fold.\(^13\) It is associated with increased risk of post-stroke mortality, disability, longer hospital stays and lower rates of discharge home. Between 1/5 and 1/6 of all strokes are due to AF.\(^12\)\(^,\)\(^14\) AF also increases this risk of subsequent heart failure.\(^15\)

Atrial fibrillation is divided into the following diagnostic categories:

- **Paroxysmal AF** – self-terminating, recurrent episodes of less than 7 days
- **Persistent AF** – sustained episodes of between 7 days and 12 months
- **Permanent AF** – sustained episodes of greater than 12 months where cardioversion (restoration of sinus rhythm) has failed or been foregone
- “**Lone atrial fibrillation”** – AF in the absence of any other structural heart disease, however patients may have any of the above patterns

These categories are not mutually exclusive and up to 90% of paroxysmal episodes are asymptomatic.\(^16\)\(^,\)\(^17\) Estimates of the relative proportion of paroxysmal AF range from 25-62%,\(^18\)\(^,\)\(^19\) with it representing a greater proportion of AF in younger people.\(^20\) Patients often move between the different states, and many progress to permanent AF.\(^21\)\(^,\)\(^22\)

Secondary AF occurs in the setting of acute myocardial infarction, cardiac surgery, pericarditis, myocarditis, hyperthyroidism, or acute pulmonary disease, and is considered a separate clinical entity. Usually, treatment of the primary condition terminates the AF.\(^12\)
The Cost of Atrial Fibrillation

The cost of AF has been examined in North America, Europe and Australia. The American, French and UK analyses considered direct costs only, whereas an Australian report described both direct and societal costs. None of the studies placed a monetary value on reduced quality of life.

The direct costs include inpatient hospital services, outpatient hospital services (including specialist testing and specialist consultations), general practitioner consultations, pharmaceutical costs, pharmaceutical adverse events, and laboratory tests. There are additional direct costs of care relating to complications, such as stroke, heart failure, dementia and death, including disability expenditure and residential aged care costs.

The 2010 Australian report by PricewaterhouseCoopers and commissioned by the Australian National Stroke Foundation included non-financial costs due to lost productivity from absenteeism, premature death and unpaid carer costs. Total direct health system costs were AUS$874 million, with total costs of AUS$1.25 billion. The societal costs represented approximately 15% of the total cost.

Information from the FRACTAL registry in the US showed the annual cost of AF treatment varied from US$3,345 in patients with no documented recurrences, to US$10,312 with 3 or more recurrences. More than half the costs were due to hospitalisation. The French study also showed the main cost driver was hospital admission. The French study also showed the main cost driver was hospital admission.

A UK study estimated the annual cost of AF at £459 million (in year 2000 £s) but that figure is almost certainly underestimated as the study neglected to include costs “related to stroke rehabilitation, digoxin toxicity, and warfarin or aspirin related haemorrhage” and did not include “a minimum of an additional £111 million also spent on admission to nursing homes”.

Burden of AF in NZ

Current evidence on incidence and prevalence of AF in New Zealand is limited. Internationally, prevalence rises from 0.5% in those less than 60 years of age, to >10% to those over 80 years of age, as seen in Figure 1. This shows the annual incidence of AF is 0.23% and its prevalence is 2.0%.

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1 Due to limitations in international administration data sets in ascertaining the true prevalence of disorders, the prevalence rate was estimated by including any patient with a diagnosis of AF in the last 20 years and a current prescription for one of 13 relevant cardiac medications, and those with a diagnosis of AF in the last five years.
Age standardised data from 2001-02 suggested that Maori had almost twice the rate of AF as compared with the total New Zealand population.27 This appears consistent with updated age-standardised NZ discharge data where the prevalence of AF in Maori is 2.3%. Additionally, it affects Maori at a younger age, with prevalence in 40-60 year-olds 1.78 times the non-Maori population of the same age. These results are not significantly changed when standardised for deprivation level. Age-standardised data shows that Pacific people have a similar rate to that of the general NZ population.

In 2010-11, approximately 2.3% of those patients diagnosed with AF were admitted with a stroke in the following 12 months.

Figure 1. Prevalence of Atrial Fibrillation in New Zealand

The figure shows the relationship between age and rising prevalence of AF. It shows the prevalence of AF is consistently higher in Maori, whereas the prevalence in Pacific and European patients conforms closely.

Source: NHC executive analysis of national collections.
The geographical distribution of AF prevalence is shown in Figure 2.

Source: NHC executive analysis of national collections.

Future Burden

The future burden of AF is difficult to predict but its incidence and prevalence increase significantly with age. New Zealand, like many OECD countries, has an ageing population with low fertility and mortality rates.

Using the most commonly used population prediction from Statistics NZ (medium fertility, medium mortality and a net migration of 10,000 per annum) the number of New Zealanders aged 65 and above is predicted to increase by 37% by 2022 and by 136% by 2061, when compared to 2012. This age group will also represent a greater proportion of our population (14% in 2012, 17% in 2022 and 25% in 2061).²⁸

If we assume that the proportion of the population affected by AF at each age remains the same, then the prevalence of AF will rise to 2.4% in 2022 (~117,000 people) and 3.8% in 2061 (~216,000 people).
Treatment

Treatment of AF is aimed at reducing symptoms, preventing cardiac remodelling and reducing the risk of stroke, heart failure and death through one of two strategies:

- Rate-control strategy – maintenance of heart rate with medication to within normal physiological bounds with no attempt to restore sinus rhythm (SR)
- Rhythm-control strategy – maintenance of sinus rhythm with either medication, catheter ablation or, more rarely, surgery.

Stroke risk is lowered through anticoagulant ("blood-thinning") medication depending on each individual's risk of stroke, regardless of treatment strategy. Multiple trials have demonstrated no significant difference between rate- and rhythm-control strategies in rates of mortality and stroke.\(^{29-32}\)

**Rate-control**

In this strategy patients remain in atrial fibrillation with no attempt to restore sinus rhythm. The heart rate is controlled with medication (usually β-adrenergic blockers, calcium-channel blockers and/or digoxin) to reduce symptoms and increase exercise tolerance.

If the heart rate is difficult to control with medication alone then rarely some patients will require pacemaker insertion to reduce symptoms and improve function.

**Rhythm-control**

In this strategy, once AF is identified normal electrical activity of the atria is restored either medically or electrically. An attempt is then made to maintain sinus rhythm with anti-arrhythmic drugs (AADs; primarily amiodarone, flecainide or sotalol). Once sinus rhythm is restored, its long-term maintenance is usually attempted with anti-arrhythmic medication (either taken regularly or at the onset of symptoms). This strategy is variably effective and whilst 40-90% of people continue to have paroxysmal AF, the frequency and intensity of their symptomatic episodes is reduced. One study suggested that intermittent ECG monitoring for recurrence underestimates the burden of AF by approximately 40%.\(^{16}\)

Alternative strategies include catheter or surgical ablation (destruction of certain areas of the atria) to prevent abnormal AF signalling. Surgical ablation is usually only undertaken in addition to cardiac surgery being performed for another reason. If rhythm-control cannot be maintained then patients will move to the rate-control strategy.

**Anticoagulation**

Anticoagulation is not mandated, but is based on each patient’s risk of stroke, independent of treatment strategy. Stroke risk is commonly determined by a risk stratification index based on
clinical risk factors (commonly CHADS$_2$ or CHA$_2$DS$_2$VASc). Aspirin, warfarin or no anticoagulation may then be recommended.

Warfarin anticoagulation is more effective than aspirin but comes at the cost of an increased risk of bleeding, including major haemorrhage and death. The most recent NZ guideline (2005) suggests discussion of aspirin use for patients at low-risk of stroke, discussion of aspirin or warfarin for patients at intermediate risk, and warfarin administration for patients at high-risk. Warfarin also has significant disadvantages in that it requires for frequent blood test monitoring, multiple drug-drug and food-drug interactions and dosing individualised to response (i.e. different doses for different patients).

Recently, a new class of antithrombotic agents has been trialled (direct thrombin inhibitors). These medications appear as effective, with a similar rate of significant bleeding, no requirement for blood tests, standard dosing schedules but are more expensive. In 2011, dabigatran was the first of this class approved for use in New Zealand.

Rationale for more effective rhythm-control

There are physiological reasons to believe maintenance of co-ordinated atrial contraction is beneficial. It allows more efficient filling of the ventricles, increased cardiac output and prevents cardiac remodelling. The longer AF persists the more difficult restoration of sinus rhythm is made, largely due to this remodelling. Restoration of sinus rhythm may result in improved quality of life, decreased stroke and heart failure risk and improved survival.

Post-hoc analysis of trial data has shown that those patients in which sinus rhythm is maintained may have a lower rate of stroke and mortality. In the landmark AFFIRM trial a retrospective analysis of patient outcomes found that those patients in SR (independent of treatment strategy) had hazard ratios of 0.63 for stroke and 0.53 for mortality. The benefit of effective rhythm-control was possibly offset by the increased risk of mortality due to anti-arrhythmic medication itself (HR 1.49). Maintaining sinus rhythm may also be beneficial in terms of quality of life, exercise tolerance and prevention of heart failure. Although retrospective data is strongly suggestive, these hypotheses are yet to be proven in prospective trials.

These finding and inherent difficulties in monitoring for true AF recurrence, the poor efficacy of AADs at maintaining SR and the increased mortality associated with AAD use have led physicians to believe that alternative methods of rhythm-control would offer improved patient outcomes.
Catheter Ablation in AF

Cox and colleagues have been credited with demonstrating the efficacy of surgical ablation in AF (eventually developing the MAZE-III procedure)\textsuperscript{46}. This led Cardiologists to attempt similar ablation techniques non-surgically. In the late 1990s a major advance came with the discovery that abnormal electrical signals originating in the pulmonary veins (and elsewhere) could “trigger” AF, and that these could be obliterated with the use of catheter ablation.\textsuperscript{47,48} Catheter ablation for AF has subsequently become one of the most commonly performed ablation procedures around the world.\textsuperscript{49}

Catheter ablation (CA) is an elective, minimally invasive procedure most often performed under sedation. A catheter is passed through the veins into the heart, with guidance of fluoroscopy and 3-D mapping systems. A destructive energy source (alternating electrical current, cryothermal, microwave, ultrasound or laser) is used to damage an area of atrial tissue, electrically isolating these triggering signals and preventing activation of the normal muscle. Electrical isolation of the pulmonary veins (PVs) is the cornerstone of the procedure, though there are many specific techniques and patterns of ablation used\textsuperscript{40}. Each procedure may take many hours and requires specialist staff, equipment and theatre facilities.

Radiofrequency ablation (RFCA) has been studied most extensively and uses alternating electrical current to damage tissue. Cryoablation (using nitrous oxide to freeze tissue) is the most commonly used alternative and recent studies suggest it has similar short term efficacy.\textsuperscript{50}

Heart Rhythm UK has defined minimum standards for equipment and staff required to perform EP studies and catheter ablation:\textsuperscript{51}

- Each physician should perform at least 50 cases each year as first operator.
- Centres performing complex ablation should have at least 2 Cardiac electrophysiologists
- Centres performing AF ablation should have surgical cover on site.
- Cardiologists performing catheter ablation must audit their personal complications and share these in an anonymised form.

Efficacy

In analysing the efficacy of CA in AF, there are significant challenges to interpretation of the data. There are only a few randomised controlled trials (RCTs) comparing catheter ablation with the alternative, anti-arrhythmic drug therapy. They are heterogeneous in design, inclusion and exclusion criteria, ablation technique used and patient population (i.e. paroxysmal and/or persistent AF). Most used freedom from AF at 12 months as their primary endpoint, and no published RCTs have examined rates of stroke, heart failure and mortality. The CABANA trial which is currently
underway seeks to answer some of these questions.\textsuperscript{52} This trial completed recruitment in February 2009 but final results are still some years away.

Most randomised trials have included a younger population (mean <60y) with few comorbidities and predominantly paroxysmal AF. There are a number of non-randomised trials and registry data that help clarify its role in a broader population but these data sources are less reliable.

Catheter ablation may have benefits in terms of reduction in: short- and long-term rates of recurrent AF; hospital admissions; stroke and mortality; long-term sequelae, including heart failure; avoidance of anticoagulation and improved quality of life.

\textbf{1. Freedom from AF at 12 months}

There are at least 8 RCTs comparing RFA and AADs.\textsuperscript{53-60} All used freedom from AF at 12 months as their primary endpoint.

After catheter ablation 56-94\% of patients were free from AF at 12 months, compared with 4-43\% of those treated with AADs alone. There was an 11-40\% repeat procedure rate. A Cochrane review (2012) showed a 73\% [CI 59-82\%] reduction in relative risk of AF recurrence with RFCA across seven of the studies.\textsuperscript{61} A recent meta-analysis of 63 randomised and non-randomised trials, and the most recently completed worldwide survey of catheter ablation showed comparable efficacy rates.\textsuperscript{62,63}

Generalising these results, RFCA has a 60-80\% single procedure efficacy with an approximate 20-40\% chance of requiring repeat procedures. Clearly, RFCA is more efficacious than AADs at maintaining sinus rhythm over the short-term.

\textbf{2. Long term freedom from AF}

Although impressive success rates after ablation are seen in the first 12 months there have been doubts raised about the rate at which AF recurs after this. Electrical reconnection of the PVs is universally observed with late AF recurrence,\textsuperscript{40} highlighting the shortcomings of current technology in creating permanent pulmonary vein isolation. Clearly, it is important to determine the durability of responses for a procedure that has high up-front costs.

One RCT has reported 4-year follow-up data.\textsuperscript{64} At 4 years 91\% in the RFCA group were free of AF compared with 12\% in the AAD group. 27\% required repeat procedures. Non-randomised data suggests lower success rates at 4-5 years, between 58-80\%.\textsuperscript{65-67} Approximately 5-20\% of patients also required AADs to maintain SR.

The 2010 worldwide survey suggests an average of 1.3-1.4 procedures/patient are required to achieve long-term success rates of approximately 80\%.\textsuperscript{63}
3. **New Zealand perspective**

A retrospective audit of catheter ablation in Christchurch was published in 2011. The mean age of patients was 51 years. When compared with overseas results, it showed comparable efficacy at 12 months after a single procedure (74% for paroxysmal AF) and a comparable long-term repeat procedure rate of 41.2%. This covered a period from 2001-2009 over which significant technological advances have been made increasing efficacy and efficiency. The chance of being AF-free at 5 years after all procedures was 95% for paroxysmal AF and 74% for persistent AF. The complication rate was 6% (major complications 2.5%, no deaths).

4. **Reduction in hospitalisation**

Reduction in symptomatic AF has been one of the key indications for CA in AF. Important cost savings could be made by reducing hospital admissions due to symptomatic episodes. The quality of evidence in this area is poor. When examined in RCTs little detail was reported as to the reasons for readmission in both the AAD and RFCA groups.

However, both Wazni et al (9% v 54% 1-year readmission rate) and Pappone et al (24 admissions v 167 admissions) showed a significant drop in hospitalisations after RFCA, but neither quantified the duration of admission or the associated costs. Stabile et al. showed no significant difference in admission rates.

5. **Stroke and Mortality**

There are no randomised trials examining RFCA’s effect on the rates of stroke and mortality, but the CABANA trial seeks to address this. Retrospective and registry data suggest RFCA is associated with lower rates of mortality and stroke. In fact, one study suggests that the risk of stroke returns to that of the general population following RFCA.

Registry studies have shown a risk of stroke of 0.4-2.4% following RFCA compared with 2.8-7.4% in matched medically treated cohorts. Mortality is notoriously susceptible to selection bias in non-randomised trials, but Hunter et al. demonstrated a 0.5% per year mortality rate versus 5.3% per year in a medically matched cohort.

6. **Quality of Life**

QoL has been examined in at least 3 RCTs, all of which showed an improvement in QOL with RFCA. QOL scores were best in those in whom sinus rhythm was maintained and approached the QOL scores of the general population.

7. **Avoidance of anticoagulation**

One of the purported benefits of RFCA is the avoidance of anticoagulation, with its associated drug, laboratory and morbidity costs. However, current guidelines suggest that anticoagulation should be continued regardless of the success of RFCA, in accordance with individual risk as
described above.\textsuperscript{14,27,40} This recommendation is based on the lack of Level A evidence showing a reduction in risk of stroke following RFCA.

There are a number of trials that suggest there is a low risk of stroke in those who discontinue anticoagulation after ablation.\textsuperscript{70,71,74,76} If it was proven safe to stop anticoagulation this could reduce on-going treatment costs following RFCA compared with standard practice.

8. **Heart failure**

Co-morbid heart failure reduces the single procedure efficacy of RFCA, but reasonable efficacy can be achieved with repeat procedures.\textsuperscript{40,45} RFCA, when compared to AV node ablation and dual chamber pacing, showed improved QOL, exercise capacity and LV function.

9. **Long-term sequelae**

One consideration that is not clear in the literature but is potentially important is the prevention of progression from paroxysmal AF to permanent AF and thereby the prevention of the long-term sequelae, e.g. heart failure, premature admission to nursing homes and carer costs.

**Efficacy in permanent/persistent (“non-paroxysmal”) AF**

The have been no RCTs exclusively in this group of patients, but many non-randomised studies have shown that RFCA is variably efficacious in this patient population.\textsuperscript{77} Success rates of 50-70% in an optimal patient with persistent AF might be expected, compared with <40% in AF of 4 or more years duration. Although the use of CA is expanding in this group of patients, its role is still an area of significant debate. There is no real consensus on either the specific techniques and patterns of ablation that should be used and the general role of RFCA.\textsuperscript{49}

**Limitations/Future Directions**

The most significant limitation is the lack of randomised data regarding stroke, heart failure and mortality between different treatment strategies. We also have little direct evidence of which particular treatment strategy is the most efficacious in reducing hospitalisation and subsequent healthcare resource utilisation.

The clinical opinion of CA in AF from international societies and European and American experts is clear.\textsuperscript{47,76,77} It is seen as critical to the array of treatment options available for those with AF, particularly paroxysmal AF.\textsuperscript{49,78,79} The exact ablation technique and the refining of energy delivered to the muscle is an area of research, with the goal of achieving more permanent isolation of the pulmonary veins and reducing the number of repeat procedures. Tools to shorten procedure times, alternative and safer energy sources and even “remote/robotic” tools are being tested.\textsuperscript{49}
Safety

Safety is a major concern for those undertaking RFCA in a young and otherwise relatively well patient group. Although complications are infrequent, they can be significant and serious. Complication rates are 4-6% and mortality is less than 0.1%.

RFCA for atrial fibrillation is one of the most complex interventional cardiac electrophysiology procedures performed. The most important complications are: cardiac tamponade (~1.5%); pulmonary vein stenosis (~1.3%); peri-procedural stroke/transient ischaemic attack (~1%); vascular injury (0.5-2.0%); atrio-oesophageal fistula (0.1%).49,63,80 Dagres et al. found that mortality of RFCA was similar to that of AADs after 1 year of treatment.81

Complication rates are declining as the technique is refined. One centre of excellence has seen complications fall from 11% in 2002 to 1.6% in 2010.49 Cryoablation has a similar safety profile but notably there have been no documented cases of atrio-oesophageal fistula.82

Guidelines

International

A number of international guidelines and consensus statements have been published in this area. The key guidelines and recommendations are listed below.

- HRS/EHRA/ECAS Consensus statement on Catheter and Surgical ablation for Atrial Fibrillation (2012)40
- ACCF/AHA/ESC Guidelines for managing patients with atrial fibrillation (2006) and the focused update (2011)83
- ESC Guidelines for the management of atrial fibrillation (2010)14
- Canadian Cardiovascular Society Atrial fibrillation guidelines 2010: Catheter ablation for atrial fibrillation/atrial flutter.84

Key recommendations:

1. **Class 1 (i.e. catheter ablation is recommended)** –
   - Symptomatic AF and failed at least one anti-arrhythmic drug (“second-line”)
2. **Class 2a (i.e. catheter ablation is reasonable) –**

- Symptomatic “non-paroxysmal” AF after at least one failed AAD
- **Prior** to AAD in selected patients with paroxysmal AF ("first-line")

The final recommendation is a significant change compared to earlier guidelines, as it broadens the potential population in whom EP is appropriate. As studies in this area mature, the trend has been for widening indications for intervention.

**New Zealand Guidelines**

New Zealand’s most recent guideline on management of AF was published in 2005, and thus lacked much of the current data available. At that time the recommendation was that catheter ablation be limited to “highly-selected people with drug-refractory PAF [paroxysmal AF] and structurally normal hearts”. This restriction was due to lack of randomised trial data and “limited experience with this procedure” in New Zealand.

The New Zealand guidelines are far more restrictive than the more recently published international guidelines. The implication of this difference is that if New Zealand were to follow international guidelines the population for whom catheter ablation would be indicated would expand significantly.

**Cost-effectiveness**

**Studies**

A number of studies have looked at cost-effectiveness of RFCA compared to anti-arrhythmic drug (AAD) therapy. All have limitations, with differing methodology and contradictory findings.

Reynolds et al. (2009) found that over 5 years the absolute costs were US$26,584 and US$19,898 of RFCA and AAD therapy respectively, which gave an ICER of US$51,431/QALY. Due to decreased health care costs in years following RFCA, the procedure became cost-neutral at approximately 10 years. The high up-front costs of RFCA contributed significantly to the ICER in the 5 year analysis. When compared to an earlier Canadian study the authors felt the “higher up-front costs of ablation in the United States” will have contributed to a longer timeline for cost equalisation. Stroke and mortality risk were considered equal in both groups.

Chan et al. (2006) did assume a differing rate of stroke, and used multiple different scenarios to determine cost-effectiveness. For a 55 year-old with a moderate risk of stroke RFCA had an ICER of US$28,700/QALY, whereas for a 65 year-old patient with a low risk of stroke on aspirin the ICER

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2 ICER (Incremental cost-effectiveness ratio) – the ratio of change in costs to incremental benefits of a therapeutic intervention. This is usually expressed as a monetary amount per quality-adjusted life-years (QALYs) gained.
was US$98,900/QALY. In this study, stroke risk was assumed to reduce following RFCA. This study shows that cost-effectiveness is sensitive both to reduction in stroke risk and selection of the appropriate treatment population.

McKenna et al (2009)\(^86\) published the results of model using UK costs, which then on to be published as a full Health Technology Assessment (HTA) analysis described below.

**HTA organisations**

A number of HTA organisations have examined CA in AF. A CADTH review (2002)\(^89\) and Swedish Council on Health Technology Assessment (2010)\(^90\) both found that there was insufficient evidence to draw a conclusion on its cost-effectiveness.

Rodgers et al (2008)\(^91\) published the full HTA of the McKenna paper above, with a more detailed explanation of the statistical and sensitivity analyses. They found that if QOL benefits are maintained for the lifetime of patients, then RFCA has an ICER (Incremental Cost-Effectiveness Ratio) of £7,768–£7910, but that if these benefits were only maintained for 5 years then the ICER £20,831–£27,745. The UK National Institute for Clinical Excellence considers an ICER of £20,000–£30,000 of only borderline cost-effectiveness.

The Ontario Medical Advisory secretariat published an HTA in 2006 that showed, even with conservative estimates, RFCA with advanced mapping techniques became cost-neutral at 4.5 years compared with AADs.\(^92\) In contrast, Assasi et al. (2010)\(^69\) developed a similar model to that of Rodgers et al., based on Canadian data and costs, and with a 5-year time horizon the ICER was CA$59,194. The cost-effectiveness was highly sensitive to the time horizon used, with RFCA becoming cost saving with a 20-year horizon.

An Institute for Clinical and Economic Review analysis (based at Massachusetts General Hospital’s Institute for Technology Assessment (ITA) and an affiliate of Harvard Medical School) showed the importance of targeting the correct patient population.\(^93\) For a 60 year old male patient with paroxysmal AF the ICER was US$37,808, whereas a 75 year old male patient with persistent AF, diabetes mellitus and hypertension the ICER was US$96,846.

In summary, these HTA assessments suggest that EP in AF is of variable cost-effectiveness, but the results of the analyses are highly dependent on certain aspects. These models are most sensitive to:

- Patient population analysed
- Utility decrements assigned to the AF state
- Assumptions of duration of benefit post-RFCA
- Cost of the procedure.
None have sought to define a patient population in which RFCA may be most cost-effective.

**Limitations**

The assessments described above show the complexity of this area. The UK and Canadian models are comprehensive and suggest that RFCA is of borderline cost-effectiveness. However, without adequately analysing the reduced costs as a result of fewer symptomatic episodes of AF in the years following ablation, these analyses will underestimate the benefit of RFCA.

The Canadian and United States analyses suggest that RFCA reaches a point of cost-neutrality 5 to 10 years after the procedure. The importance of higher procedural costs was demonstrated by the US data which had the longer timeline to cost neutrality.

Despite the detail, these models are hindered by some important assumptions. They may have underestimated RFCA benefit due to fewer hospitalisations after the procedure (a significant cost-burden). Equally, some the models may have overestimated the benefit by assuming a reduced rate of stroke (currently unproven), and maintenance of QOL benefits linked to specific time intervals rather than matched to sinus rhythm. If RFCA does not reduce stroke and mortality, and the requirement for repeat procedures increases over longer timelines, then it may not be cost-effective.

Other general limitations must be considered when examining these results from a New Zealand perspective. Most of the information and analysis is from either North America or Britain which have different patterns of care, costs, levels of experience, use of technology and levels of remuneration. Although NZ clinical practice is similar to that of the UK its thresholds for cost-effectiveness are not generalisable.

**Societal and Ethical**

**Acceptability and Satisfaction**

AF patients typically have low levels of knowledge about AF and there is a lack of consistency in their knowledge, attitude and behaviours to more positively influence health and well-being.

Satisfaction with current AF treatment is low in patients with AF, and physician satisfaction with available AF drugs is driven by efficacy. Patient satisfaction, compliance, and functional ability increase with perceived improved treatment efficacy. This was more recently confirmed in relation to ablation therapy, stating that “persisting symptoms after the ablation procedure was a significant predictor of patient satisfaction”.

It is likely, therefore, that catheter ablation will be more satisfactory than anti-arrhythmic drug therapy to patients and doctors, as it is more efficacious and requires less on-going drug therapy.
Ethical considerations

The ethics of funding CA are complex. CA is a relatively new and evolving technology that has a number of indisputable indications and is already embedded in our public health sector. It is increasingly being seen as an integral part of the treatment spectrum of AF. The cost-effectiveness is yet to be proven but despite this the recommended indications for its use in AF are widening.

Further investment in a technology that has yet to be proven cost-effective sets a potentially dangerous precedent, yet disinvestment in an established, efficacious and internationally recommended procedure, that has yet to be proven insufficiently cost-effective, is potentially unethical too. From a societal perspective the funding is likely to be a complex decision as wider benefits, that have not be sufficiently examined in the literature to date, may influence this decision.

Defining an appropriate treatment group is also difficult. CA is a costly and limited resource in New Zealand and its scarcity requires a degree of patient prioritisation. Equitable and transparent access will be key considerations as currently intervention rates differ across ethnicities and deprivation levels. The population for whom CA is both appropriate and cost-effective is likely to represent only a tiny proportion of the total number of people with AF.

Catheter Ablation in New Zealand

Catheter ablation in New Zealand is still a small component within Cardiology services, representing 5% of total Cardiac expenditure in 2011 (Case weight discharge data). There are 8-9 Cardiac electrophysiologists across the country. The services are well-established in Auckland, Christchurch and Waikato. Although Capital and Coast DHB have EP facilities but they are awaiting a Cardiac electrophysiologist to be cleared to work in order to reintroduce services.

The graph below (Figure 1) shows the prevalence of AF in the NZ population divided by age, and the EP intervention rate in the population known to have AF. This shows AF prevalence increasing with age, but contrastingly almost all EP is performed in those younger than 65. The median age of intervention in 2011 for AF was 60.

It must be noted that these analyses are only estimations as there are significant limitations in analysing local data. Assumptions and coding inaccuracies inherently introduce some imprecision in the results. In order to produce more reliable and precise results relevant data collection would need to be improved.
Figure 3. AF Prevalence and catheter ablation by age.
This figure shows that although AF prevalence increases with age interventions occur at younger ages. EP rates are expressed as a percentage of the total AF population in each age band.

NZ 2011 Estimates

Source: NHC executive analysis of national collections.

Regulatory status
Devices used in EP procedures must be registered with the New Zealand WAND database. There are nine suppliers of cardiac catheters, offering more than 50 different catheters, with prices ranging from $800-$8,694, depending on complexity. Consumables can contribute up to 40% of the procedural cost. There is currently no national procurement agreement for devices in this area.

Expenditure
Clinical coding limitations prevent a precise estimation of the activity and cost of CA for AF nationally. Additionally, AF and atrial flutter are not reliably distinguishable in the data sets as they are not coded separately. This is significant as the success of ablation and indications for it are different between the two conditions despite being closely related.

Based on Case Weight Discharge (CWD) expenditure data, Cardiology expenditure increased by NZ$22M (20%) between 2006 and 2011. In contrast, there has been only a 13% increase in CWD expenditure for catheter ablation of AFL and AF since 2006, despite a 26% increase in total cardiac electrophysiology procedure volumes. In 2011, cardiac electrophysiology represents only 5% of total Cardiac expenditure. Expenditure on CA for both AF and AFL in 2011, based on CWD, was $4.9M comprising approximately 45% of the $10.8M cardiac electrophysiology costs, as shown in Figure 4.
Figure 4  Expenditure on cardiac electrophysiology by arrhythmia type. Spending on AF/AFlutter in 2011 was $4,920,179 out of a total of $10,847,781.

Expenditure on inpatient electrophysiology at 2009 prices

Source: NHC executive analysis of national collections.

EP represents only a small proportion of Cardiac expenditure at the present time and has shown a lower than average growth in expenditure, suggesting there already exists an internal limitation on increasing access.

Distribution by Region

Figure 5 below compares the prevalence of AF by DHB and the standardised intervention ratio for AF catheter ablation by DHB. Although the prevalence varies to a small degree across the country, EP intervention rates vary markedly and inconsistently with the prevalence. This illustrates the inequalities of access across the country. Notably, access in the lower North Island and upper South Island are disproportionately low compared with crude AF prevalence in these regions, which may be driven by the lack of an Electrophysiology-trained Cardiologist in the region.
Figure 5. Inequity in access to EP services.

The maps above show the contrast between regional distribution of AF (as seen earlier) and the EP intervention ratio across New Zealand. The intervention ratio is the local regional intervention rate compared to the national average.

**Crude AF Prevalence**

**EP Intervention Ratio**

Source: NHC executive analysis of national collections.

Inequalities of access also exist across ethnic groups, with Maori having lower rates of EP despite having consistently higher prevalence of the disease. These data cannot account for other medical factors (e.g. comorbidities) that may explain these differences.

**Cost Analysis**

Bearing in mind the significant limitations due to a lack of accurate New Zealand costing and outcomes data (which would strengthen any further assessment in this area), an attempt to understand the financial implications can be made. In addressing the funding of cardiac electrophysiology, with a focus on AF, both the current model of care and future projections should be considered.

In understanding the current delivery of care we are able to highlight ways in which current resources might be more efficiently used, and by projecting future demand an estimation of the potential future cost implications, and how these could be approached, can be made.
This can be broadly summarised into three areas:

- Assessing the current costs, cost-effectiveness and addressing mechanisms of cost-saving in the current model of care.
- Identifying those patients in whom EP has the most significant clinical and financial benefit.
- Predicting the future demand and, by addressing the potential uncontrolled growth of the service, avoid future cost.

The Current Environment

The financial impact of EP for AF has three aspects:

- Direct costs to DHBs in Hospital and Emergency Department admissions, and outpatient visits (which can be estimated with CWD data).
- Wider health system costs including GP visits, medication, lab testing, nursing home admission (which are much more difficult to ascertain accurately).
- Societal and productivity costs due to absenteeism, "presenteeism" (reduced productivity despite work attendance), carer costs and early retirement.

HTA assessments have sought to establish the cost effectiveness of RFCA as a whole. In these analyses the cost-effectiveness is most sensitive to: patient population chosen; utility decrements assigned to the AF state; assumptions of duration of benefit post-RFCA; and the cost of the procedure. Although utility decrements and duration of benefits affect HTA results they cannot be practically altered to improve cost efficiencies.

Therefore, obtaining optimal efficiency from EP resources can be approached in 2 ways:

- Targeting the appropriate intervention population.
- Reducing the procedural costs.

Targeting the Population

A complete assessment of the ideal population is beyond the scope of this paper, but the analysis below is illustrative of how targeting an appropriate population may affect EP service cost-effectiveness.

The current indications for CA for AF target those people who are both highly symptomatic and have failed drug therapy. This cohort is likely to have increased health expenditure in the years preceding CA as a result of worsening control of their AF.

Figures 6 and 7 show the hospital expenditure for those patients who underwent an EP study, with or without ablation, and who have a diagnosis of AF (differentiating this group from those who actually underwent therapeutic catheter ablation for AF is not currently possible).
By reducing the resource use in those patients, potential savings may be made. As seen in Figure 6, in the year prior to EP the hospital-related costs in some cohorts of AF patients increase significantly (presumably as a result of increasing symptomatic episodes requiring hospitalisation). Following EP, the hospital costs incurred reduce significantly. As an illustrative example of how targeting the correct population can affect cost-effectiveness and affordability, we have divided the EP population by the number of admissions each patient had in the year prior to admission (3 or greater, 2, 1 or 0).

In 2005, those patients with ≥3 admissions in the year prior to CA cost the hospital system $19,500 in the year prior to CA. The expenditure in the year of CA is approximately $28,500, but then in the years 2-5 the cost of their care reduces to $1,000-5,000 per annum. When a matched cohort of patients (matched for age, deprivation quintile, gender and ethnicity) who did not undergo CA is compared, the hospital costs are much higher in later years. The CA procedure becomes cost neutral in year 4 following ablation (including 3.5% discounting), and by 5 years the patients are actually $10,800 cheaper per patient to the hospital system than the matched cohort.

Figure 6. Hospital expenditure for those patients with ≥3 and 2 admissions in the year prior to EP. Those patients with 3 or more admissions have a higher subsequent expenditure than those with only 2 admissions.

In contrast, those patients who have two admissions in the year prior to CA show less difference hospital expenditure in the years following EP compared with a matched cohort. In these patients their care becomes cost-neutral in year 7 following CA (by year 5 they are still $6,000 more expensive). The same applies to those with one or no admissions (Figure 7). After CA their hospital costs are significantly less than a matched cohort and their care becomes cost-neutral in year 8 and year 10 respectively (if the difference in costs is extrapolated beyond year 5). There is
a clear stepwise progression in cost recovery across these groups based on their admission history prior to CA.

Figure 7. Hospital expenditure for those patients with one or no admissions in the year prior to EP.

Although there is still a difference in hospital care costs between them and a matched cohort the difference is less than the patients with 2 or 3+ admissions.

Source: NHC executive analysis of national collections.

In 2005, 5% of the total AF population had ≥3 admissions, and only 1% of these underwent CA. This suggests there may be a large number who may be appropriate for CA but in whom it is not performed. Of the 208 patients in 2005 who underwent ablation, only 23 had ≥3 admissions in the year prior. If the patients with ≤2 admissions were replaced with a cohort with ≥3 admissions, and we extrapolate the difference in hospital resource use, then this cohort costs the hospital system approximately $3,000,000-$4,000,000 less (including 3.5% discounting) at 5 years.

By altering the group of patients in whom CA is performed, it is possible to reduce the overall costs placed on hospitals by those patients with AF. If, for instance, the same number of procedures was performed as has been in recent years (approximately 280), but that CA was only performed on patients who had two or more admissions to hospital, i.e. those patients who had fewer than two admissions and would now have had CA, would hypothetically be replaced by a group with two or more admissions, a benefit could be expected in terms of reduced healthcare resource use.

This is demonstrated in two ways. Currently, patients who undergo CA have 2.7% fewer hospital admissions than those who do not undergo CA. If the group was targeted as described above, then CA would reduce admissions by 15% compared to the matched cohort. There would also be an immediate saving to the health sector (i.e. from the year of CA) as resources are moved from those who would otherwise use very few resources, to those who would use significantly more. In
fact, by doing this modelling predicts that $1.4 million of resources could be saved or used for other patients in the year of ablation (i.e year 0), and the cumulative reduction in resources use over 4 years would be $12.7 million (including 3.5% discounting).

While there is potential for error in the absolute costs, this clearly shows that there is potential to stratify groups of patients in whom CA is not only highly efficacious, but also likely to save on hospital expenditure in the subsequent years. This simple model does not include ED, outpatient and primary care costs, but the HTA modelling described earlier have found these costs have been consistently lower in CA groups compared to AAD-alone groups (due to lower drug and outpatient care costs). This would further favour cost-effectiveness of CA.

Other factors that would improve success rates and cost-effectiveness include:
1. Younger age – have a shorter duration of disease and more likely to be employed. By reducing symptoms, not only are healthcare resources appropriately used, but longer life expectancy and duration of benefit could reasonably be expected; and there would also be greater productivity/societal benefits.
2. Type of AF – success rates are higher in paroxysmal AF compared to persistent AF
3. Duration of AF – higher success rates are seen with shorter durations of AF
4. Fewer comorbidities – increase the single procedure efficacy

However, to consider performing this procedure only in a narrowly defined group of patients ignores important clinical, quality of life and societal factors that cannot be incorporated in a simple model. However, by using simple clinical measures (such as hospital admissions, type of AF, comorbidities, number of failed AADs and age) in a priority scoring system, the NZ health sector could offer this service appropriately, whilst improving cost-effectiveness.

Reducing the cost
Currently, there is no national procurement agreement for EP devices. If a national program could reduce the cost of capital investment and consumables, cost-effectiveness would inevitably be improved. With the limited information available at the current time on service organisation and workforce capacity, this is an area which will require further investigation.

Potential Societal/Productivity Considerations
The PricewaterhouseCoopers report suggests that 15% of the total costs of AF to Australia were societal costs. The population in whom EP is performed in New Zealand is generally younger and is more likely to be contributing to the economy. No study has considered these wider aspects but it seems likely that with reduced symptoms, fewer hospitalisations, and improved quality of life that the wider societal benefits would favour CA over AAD drug use. Increased economic productivity
as a result of fewer absentee days, reduced carer requirements and reduced symptoms would mean this societal benefit will make EP more attractive from a societal viewpoint.

**Potential for growth**

The potential growth in service demand is variable. Predictions are limited by the large potential population in whom CA may be used. As one of the main drivers for CA is severity of symptoms, which is not recorded in ICD coding, there is no reliable method for estimating the current size of the potential intervention population in New Zealand.

In the UK, the number of ablations for AF rose by 316% between 2006 and 2011 (from 1,120 to 4,654). The number of centres performing cardiac electrophysiology rose from 38 to 49 in the same period. The main obstacles to guideline implantation were felt to be a lack of referrals and a lack of centres. By contrast, New Zealand’s intervention rate for AF rose only 18.6% (by CWD data from 278 to 338 procedures).

Below we consider a number of potential scenarios for demand expansion over the next 10 years:
Figure 7. Potential growth in demand in catheter ablation for AF to 2022. Source: NHC executive analysis of national collections.
Scenario 1: The absolute rate of intervention remains stable at 2011 levels across all age groups (i.e. the minimum possible growth)

Scenario 2: The growth in intervention rates between 2006 and 2011 continues until 2022 but remains constant (and interventions increase in proportion with each age group)

Scenario 3: A conservative estimate as absolute intervention rates double by 2022, (based on a controlled rate of increase compared with the UK) i.e. if controlled by resource constraints.

Scenario 4: New evidence suggests EP reduces stroke risk and mortality and as indications widen the intervention rates rise at the same rate as the UK rate between 2006 and 2011 (i.e. approximately 2.3% of the AF population is treated with CA in 2022)

Scenario 5: New guidelines suggest EP should be used in the first line for paroxysmal AF in 40-65 year-olds (Assumption: paroxysmal AF represents 30% of AF in 40-65 year olds)17

Projected expenditure

Projecting the future need for EP in AF in New Zealand is difficult because as the technology develops so its indications will likely increase, but costs will fall for existing interventions as new technology evolves. There is a significant degree of speculation in each of the models.

An illustrative example:

If we assume that Scenario 2 is the base scenario and that intervention rates increase at a rate consistent with the growth over the past 5 years, and compare this with Scenario 4. Estimating the cost of each ablation procedure at $15,800 per patient (based on the median price of admission from CWD data ) then the cost of performing CA on all the patients in Scenario 4 in 2011 NZ$ would be $42.5M, compared to the base case of $11.4M, i.e. an extra $31.2M in direct expenditure. This excludes the capital costs of 3-6 extra theatres required and the extra Cardiac Electrophysiologists performing the procedures.

If the intervention numbers were limited to Scenario 3 levels then the direct cost to the New Zealand health system would be $14.8M, or alternatively $27.7M in avoided expenditure. However, these examples need to be tempered by the earlier modelling which suggests there may be a population in which a cautious expansion on the Cardiac electrophysiology service would in fact reduce overall healthcare costs.

Summary

The ubiquitous implementation of catheter ablation for atrial fibrillation is currently beyond the workforce, infrastructural and financial capacity of New Zealand. However, the analysis above shows that there is potential to target groups of patients in whom the personal and systemic
benefits are greatest. If done judiciously, the improved outcomes might allow the redirection of constrained resources in subsequent years, either to other services or to allow the health sector to better plan for, and cope with, the inevitable increased demand for EP services.

The high up-front costs are strong determinants of affordability and cost-effectiveness and if a stronger national approach is taken to capital and consumable costs it will allow for greater efficiencies.

**Non-commercial considerations**

There are additional non-commercial considerations which impact any decision on the introduction or expansion of health technologies. Workforce recruitment and retention is an important consideration as most Cardiologists combine General Cardiology responsibilities with a sub-speciality interest. There is the potential to lose New Zealand-trained and -experienced Cardiologists overseas if overly severe restrictions are placed on their scope of practise.

Cardiac Electrophysiology is a growing sub-speciality, and is becoming popular with Cardiology trainees, with 5-6 NZ trainees expressing an interest in EP. This compares to a current 1.8FTE for EP at ADHB. The 2009 US national average of Cardiac Electrophysiologists is 7.8/1,000,000 population, with 8 states having <5.6/1,000,000. This compares with New Zealand’s current EP specialist workforce of 2/1,000,000. This suggests that New Zealand is relatively under-resourced in this area, even acknowledging the difference in practise between North America and New Zealand.

Electrophysiology technology is constantly evolving with improving outcomes and falling complication rates. Careful service configuration and wise investment could enable New Zealand timely access to newer techniques and technologies that are definitely cost-effective and/or cost-saving in this area.

**Data quality**

This report has highlighted the effect data limitations have on accurate analysis. Catheter ablation is a procedure with significant up-front costs but which appears to deliver improved outcomes for patients. In order to make interventions such as these more robust to cost-effectiveness and outcomes scrutiny, a more complete record of the clinical and financial impacts would be a significant asset.

There are local and international precedents in this area. In 2009, the Australian and New Zealand Society for Vascular Surgery made participation in a bi-national audit a “necessary requirement for ordinary members to maintain membership of the ANZSVS.”
A registry of cardiac electrophysiology intervention would aid timely and appropriate clinical and financial data analysis to guide service development, adaptation and improvement, as well as providing academic opportunities for those involved. A registry could include both clinical and financial outcomes.

**Conclusions**

Cardiac Electrophysiology services are a crucial part of the New Zealand’s Cardiac services, but they are also a finite resource with significant capital expenditure and procedural costs. Their scarcity, on-going evolution and specialisation, and potential for growth in demand, with difficulties in providing equitable access across the country make this an area that will require a strategic planning and monitoring to ensure we provide an efficacious and cost-effective service for New Zealanders.

Waiting list information is inadequate, national costs and outcomes difficult to assess and appropriate national prioritisation of potential patients non-existent. Catheter ablation in AF highlights the challenges ahead. Improving health outcomes and addressing inequalities will require a concerted and co-ordinated effort that allows efficient use of resources, workforce retention, recruitment of skilled staff, and on-going engagement with the sector.

International analyses of the cost-effectiveness of RFCA in AF have had variable results, but a number of clinical guidelines recommended it in specific populations. Analysis of the New Zealand data suggests that patients with AF who undergo EP ablation cost the NZ health system less in the years after the procedure, and that there is a possibility that this procedure can be cost-neutral or even cost-saving over time. Additionally, if CA in AF proves to reduce the long-term sequelae, there may be potential cost savings beyond those considered in cost-effectiveness analyses.

There is also a tension between the payer perspective and the national-societal perspective. With its high upfront and capital costs DHBs are likely to want to contain costs in this area; however, from a societal perspective catheter ablation is likely to reduce societal costs based on absenteeism and carer requirements. Careful implementation and patient selection may allow synergism of societal and payer objectives.

The role of the NHC in this area is to initially highlight these issues to the sector and engage experts in cardiac electrophysiology, structural organisation and development, and funding and purchasing to develop a sensible and effective strategy for service development and monitoring. Current limitations in outcomes and financial data collection limit stronger recommendations, and further monitoring and analysis would allow more informed service design and planning.
If this intervention proves not to be cost-effective then we must be prepared to steer resources to practises that will provide better value for money, but if it proves to be cost-saving then a co-ordinated plan for workforce requirements, structure and development will be required.
References


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