National Audit Cardiac Rhythm Management (NACRM) Report 2024

Date: 11 March 2025

Most recent data April 2023-March 2024

This document contains explanatory notes about the audit. It should be read in conjunction with the National Audit Cardiac Rhythm Management (NACRM) report.

Miscellaneous

The Domain Expert Group (DEG)

More recently, clinical leadership has been provided by the British Heart Rhythm Society (BHRS), the successor to the British Pacing and Electrophysiology Group (BPEG), and an affiliated group of the British Cardiovascular Society (BCS). This DEG sets the strategy and provides oversight of the audit. It is chaired by the clinical lead and meets regularly. The DEG includes NICOR staff, the BHRS President and Audit Lead, and representation from all professional groups involved with CRM CIED management (doctors, physiologists, and nurses). There is also lay representation, representation from the charity sector and the Medicines and Healthcare Products Regulatory Authority (MHRA).

Confidentiality

Data submitted to NICOR for all the cardiac audits are by their nature patient-identifiable (and need to be to permit centres to check and update records). They are, therefore, held on a highly secure server. This means that identified centre audit leads are able to use secure logins to see and check their own centre's data at a patient level. However, these data are not released in a patient-identifiable form to any other parties. Even within NICOR, the data management team are separate from the analysts and audit leads.

Any patient-identifiable data in extracts is encrypted. The NHS number is converted into a string of 16 alphanumeric characters (hashing). This permits NICOR to identify whether a patient has had more than one procedure, but the string cannot be converted back to identify the NHS number. Dates of birth are not visible to the analysts and audit lead, only age (to the nearest year). Postcodes are converted to geographic identifiers. Only aggregated data can be used for analysis or publication.

There is a process whereby researchers can obtain data for analysis on our website here: DARS process.

Data Collection and IT

As the CRM audit database largely relates to procedures performed, most hospitals collect data at the time of these procedures. Data can either be submitted directly to NICOR via a web portal or collected by hospital information systems and uploaded in batches. As a variety of information systems are used, with at least six major third-party IT providers, changes to the dataset can pose a challenge, and adherence can be delayed. Revised datasets were announced in 2013 and implemented in 2014, but adoption by centres was not complete until 2015. The 2015-16 report was the first to be based entirely on the new dataset.

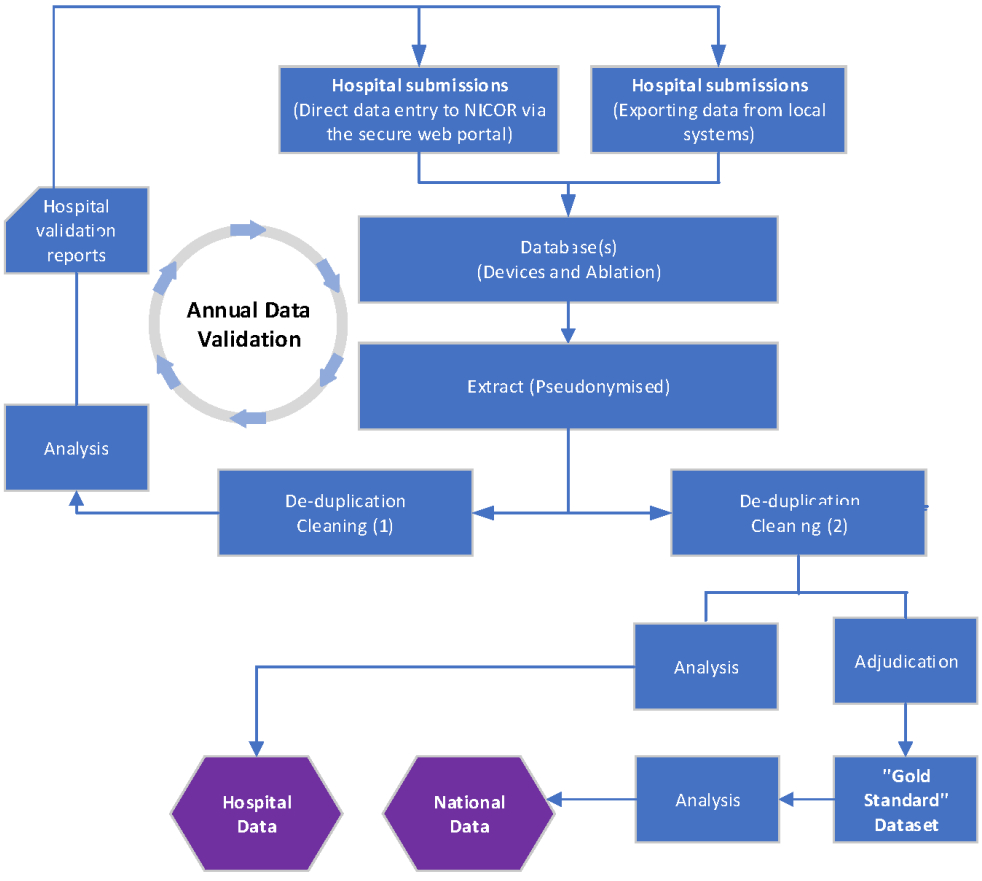
It is clear that a refreshed dataset is required to cope with new technologies and also collect additional patient-related factors to facilitate audit. In particular, there have been calls to collect data on body mass index and additional fields pertaining to congenital heart disease.

It seems likely that NICOR will have to mandate direct data entry into its systems, pushing data back to third-party systems in real time.

Data processing

The flow for data processing is shown below in Figure 1.

Figure 1. Data Processing Flows



Data submission centres submit their records either by typing directly into the NICOR portal, or by uploading using comma-separated variable (.csv) files generated from local IT systems.

- *First extract.* This is prepared using all relevant fields; any patient-identifiable data are pseudonymised (see confidentiality earlier in this Appendix).

- *De-duplication.* Identified duplicate records are removed (the number of these is shown at the beginning of each individual centre report).

- *Cleaning.* Data quality among the approximately 100,000 records submitted each year is variable, and minor errors in syntax are common. Corrections are made, where this can be done without ambiguity or risk of error.

- *Validation analysis.* The analytic process for individual centre reports run to produce a first draft.

- *Validation.* Each centre is sent the validation report, showing how its data would look once analysed; a month is allowed for centres to make corrections.

- *Final extract.* A second, final extract is prepared, de-duplicated, and cleaned using identical methods.

- *Adjudication.* Some key fields are noted to be incomplete or clearly incorrect in a minority of records. Adjudicated versions of these fields are generated as follows:

    - *CIED system type.* Where the stated CIED system type is clearly incompatible with the stated generator model (e.g. the system type is stated to be a dual chamber pacemaker, but the generator model is a dual chamber defibrillator), the record is adjudicated, where necessary using other fields, such as the number and types of leads.
    - *CIED procedure type.* Where this is missing or clearly incorrect, based on compatibility with other fields, the record is adjudicated where possible.
    - *Ablation performed?.* This field is intended to distinguish procedures in which an ablation was performed from those that were purely diagnostic or where ablation was not attempted for various reasons. In a proportion of cases (enumerated for each centre in its report) this field was incomplete or clearly incorrect based on other data. Adjudication is performed where possible.

  Where adjudication of a field cannot be performed with a high degree of confidence, the field is adjudicated as unknown.

- *Final analysis.* The code is run to produce the final centre reports and the national report with its appendices. Note that unadjudicated data were used for all reporting relating to centres (so that their analyses reflect their data quality/completeness). However, the results for the national trends and the maps of implant and ablation rates across England and Wales use adjudicated data.

Annual CIED Procedure Numbers

Cardiac rhythm management (CRM) devices or cardiac implantable electronic devices (CIEDs)

The term CRM is often used to describe treatments based on implanted electronic devices such as pacemakers and defibrillators. The term CIED is becoming more common. Most CRM devices/CIEDs are implanted under the skin, with one to three leads usually threaded down a vein to connect to the heart. The implant procedure usually requires only a local anaesthetic and can take less than 45 minutes for the simplest CIEDs or more than 2 hours for the most complex. The main CIEDs are:

Permanent Pacemakers (PPMs)

These are the most common type of CIED and have been used since 1958. PPMs are implanted under the skin and connected to the heart with leads threaded down veins. They monitor the heart rate and, when necessary, give tiny electrical impulses to trigger the heartbeat. PPMs are the only treatment for slow heart rates or episodes when the heart stops altogether (asystole), which could result in dizzy spells, blackouts, or even death.

Conduction System Pacing (CSP)

Conduction System Pacing is increasing in popularity. It involves targeting a right ventricular lead to sites in the conduction system (either the His Bundle or Left Bundle Branch) rather than in the more typical anatomical sites of the apex or septum. It is hypothesised that such pacing can result in better outcomes than anatomical pacing and even cardiac resynchronisation therapy. Observational studies are promising, and large-scale randomised controlled trials are ongoing, which will define its precise indications. Conduction System Pacing (CSP) may be considered in a wide range of patients as detailed in guidelines(1)

Conduction System Pacing should be identified by audit submissions by listing the RV pacing site correctly (3.24 or 3.32, option 5, His/Conduction system). We anticipate presenting more detailed data on this in future reports. Ensure Baseline Clinical Data (Fields 2.01 – 2.10) are also complete to enable accurate data presentation.

Leadless cardiac pacemakers (LCPs)

A disadvantage of conventional pacemakers is the need for one or more leads that pass down a vein from the CIED (placed under the skin below the collarbone) to the heart. Occasionally, these can become damaged or infected, necessitating their replacement. This can be difficult and is associated with risks because the leads are bound to the veins and heart by scar tissue.

There are two recent innovations that are being tracked. A recent innovation is a pacemaker sufficiently small to be directly attached to the inside of the right ventricle. This avoids the need for leads and appears to have a significantly lower risk of infection. The techniques for implantation are evolving, and at present, they are only available in certain UK centres. Initially, only ventricular pacing was possible, but now dual chamber CIEDs able to maintain AV synchrony are available.

NICE published interventional procedure guidance in 2018 (1). Further guidance was produced by the British Heart Rhythm Society (2). However, there is, at present, little high-quality data to guide us on which patients would benefit from such a CIED.

Three models of LCP have been implanted, Micra® (Medtronic), Aveir (Abbott) and Nanostim® (Abbott); market release of the latter was suspended in 2018.

A further innovation is ultrasound-powered pacing of the left ventricle (WiSE®, EBR systems). This is used as an adjunct to conventional pacing (with a transvenous lead in the right ventricle) to achieve cardiac resynchronization therapy in cases where this is impossible conventionally (using a lead in a branch of the coronary sinus). A transmitter outside the rib cage detects the right ventricular pacing pulse and 'pings' a focused ultrasound pulse to a small receiver electrode fixed to the interior of the left ventricle.

LCPs are identified using should be identified by audit submissions by listing the model name and model number (3.20), serial number (3.21), generator site (3.17, 5. Intravascular – endocardial) and listing the maximum system capability (3.12). We anticipate presenting more detailed data on this in future reports. Devices are also searched as free text for model name and number. Ensure Baseline Clinical Data (Fields 2.01 – 2.10) are also complete to enable accurate data presentation.

Implantable Cardioverter Defibrillators (ICDs)

Most sudden cardiac arrests are due to very fast or chaotic beating of the main pumping chambers (ventricular tachycardia or fibrillation), requiring a shock to restore the normal rhythm. An ICD is an implantable CIED that can do this automatically within seconds. In the 1990s, ICD technology developed allowing ICD implantation to be similar to that of a pacemaker, without the risks of open chest surgery. This, and large-scale randomised trials, supported the standard use of ICDs to prevent sudden cardiac death.

Most ICDs can also act as pacemakers, though a new type (extravascular ICD) has no leads in the heart and cannot pace, except briefly after delivering a shock. Extravascular ICDs are used routinely in current practice. The BHRS recommends

they are considered in selected patients needing defibrillators. Developments in the technology include leadless modular right ventricular pacing devices to provide anti-tachycardia (ATP) and bradycardia pacing, and a sub-xiphisternal approach which can deliver ATP in a single device.(1) We anticipate presenting more detailed data on this in future reports. Ensure Baseline Clinical Data fields are also complete to enable accurate data presentation. Extravascular ICDs should be identified by audit submissions by listing the model name and model number (3.20), serial number (3.21) and maximum system capability (3.12, ICD-SQ, subcutaneous or extravascular defibrillator) . Ensure Baseline Clinical Data (Fields 2.01 – 2.10) and intervention category (Field 3.11) are also complete to enable accurate data presentation.

Cardiac Resynchronisation Therapy (CRT)

In some patients with heart failure, the ventricles (main pumping chambers) are not only weak but also poorly coordinated. CRT CIEDs pace the ventricles from two sites rather than one to improve the coordination of the heartbeat, 'tuning' the heart. CRT use has been widespread since around 2000 and has been proven to be a highly cost-effective treatment to improve symptoms and reduce hospitalisations and mortality. CRT can be a feature of both pacemakers (CRT-P) and defibrillators (CRT-D).

CIED system types: simple vs complex

In line with NHS commissioning structures and other professional bodies in the world, CIEDs have been classified as:

- *Simple.* Single or dual chamber pacemakers for the treatment of bradycardia. These are commissioned locally.
- *Complex.* Implantable defibrillators (ICD) for patients who have suffered from, or are at high risk of, cardiac arrest, and cardiac resynchronization therapy pacemakers (CRT-P) or defibrillators (CRT-D) for the treatment of heart failure and risk of cardiac arrest. Complex CIEDs are subject to Specialised Commissioning.

CIED procedure types: first implant and others

The new CIED dataset was designed to improve differentiation between different procedure types, including:

- *First implant.* The first time a patient has received any form of pacemaker or defibrillator. Some analyses (e.g. re-intervention rates) look only at first implants to achieve a uniform population for the calculation of complication rates.
- *Replacement.* Replacement of the generator, usually due to battery depletion.
- *Upgrade.* A change in function from a simple CIED to a complex CIED (e.g. pacemaker to ICD) or from an ICD or CRT pacemaker to a CRT defibrillator. This is, therefore, the first time the patient has received this level of therapy.

Most analyses have combined new and upgrade procedures as they represent the first time the patient has received this level of therapy. This is made explicit in each section.

Regional maps: Integrated care boards and cardiac networks

Integrated Care Boards (ICBs) replaced Clinical Commissioning Groups (CCGs) in England from 1st July 2022 (See: https://www.england.nhs.uk/publication/integrated-care-boards-in-england/ and https://www.datadictionary.nhs.uk/nhs_business_definitions/integrated_care_board.html). There are 42 in total. ICBs are responsible for planning the delivery of health care to the population within the geographical area they cover, as well as managing the NHS budget. They have their own leadership team, which includes members from the NHS Trusts in their region, as well as general practice and local authorities.

Most cardiac Networks cover larger geographical areas than ICBs. They are not responsible for budgets or planning for the delivery of care. Rather, their purpose is to bring healthcare professionals together to manage common issues that are faced by healthcare providers and help develop common pathways for care. They focus on tackling inequalities and improving outcomes, as well as improving value for money. Cardiac Networks are designed to help deliver the aims of the 2021 White Paper Integration and Innovation: Working Together to Improve Health and Social Care for All (See: https://www.gov.uk/government/publications/working-together-to-improve-health-and-social-care-for-all/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-html-version).

A list of Integrated Care Boards/Cardiac Networks

East of England
NHS Bedfordshire, Luton and Milton Keynes ICB
NHS Cambridgeshire and Peterborough ICB
NHS Hertfordshire and West Essex ICB
NHS Mid and South Essex ICB
NHS Norfolk and Waveney ICB
NHS Suffolk and North East Essex ICB

London
NHS North Central London ICB
NHS North East London ICB
NHS North West London ICB
NHS South East London ICB
NHS South West London ICB

Midlands
NHS Birmingham and Solihull ICB
NHS Black Country ICB
NHS Coventry and Warwickshire ICB
NHS Derby and Derbyshire ICB
NHS Herefordshire and Worcestershire ICB
NHS Leicester, Leicestershire and Rutland ICB
NHS Lincolnshire ICB
NHS Northamptonshire ICB
NHS Nottingham and Nottinghamshire ICB
NHS Shropshire, Telford and Wrekin ICB
NHS Staffordshire and Stoke-on-Trent ICB

North East and Yorkshire
NHS Humber and North Yorkshire ICB
NHS North East and North Cumbria ICB
NHS South Yorkshire ICB
NHS West Yorkshire ICB

North West
NHS Cheshire and Merseyside ICB
NHS Greater Manchester ICB
NHS Lancashire and South Cumbria ICB

South East
NHS Buckinghamshire, Oxfordshire and Berkshire West ICB
NHS Frimley ICB
NHS Hampshire and Isle of Wight ICB
NHS Kent and Medway ICB
NHS Surrey Heartlands ICB
NHS Sussex ICB

South West
NHS Bath and North East Somerset, Swindon and Wiltshire ICB
NHS Bristol, North Somerset and South Gloucestershire ICB
NHS Cornwall and The Isles Of Scilly ICB
NHS Devon ICB
NHS Dorset ICB
NHS Gloucestershire ICB
NHS Somerset ICB

List of Welsh Local Health Boards
Betsi Cadwaladr University Health Board
Powys Teaching Health Board
Hywel Dda University Health Board
Aneurin Bevan University Health Board
Cardiff and Vale University Health Board

Cwm Taf Morgannwg University Health Board
Swansea Bay University Health Board

List of cardiac networks

North East and North Cumbria Cardiac Network
Lancashire and South Cumbria Cardiac Network
West Yorkshire Cardiac Network
Humber and North Yorkshire Cardiac Network
Cheshire and Merseyside Cardiac Network
Greater Manchester Cardiac Network
South Yorkshire Cardiac Network
West Midlands Cardiac Network
East Midlands Cardiac Network
East of England Cardiac Network
South East Cardiac Network
North London Cardiac Network
South London Cardiac Network
West of England Cardiac Network
South West (Peninsula) Cardiac Network

References:

1. British Heart Rhythm Society Standards for Implantation and follow-up of cardiac rhythm management devices in adults. January 2024 revision. Accessed at https://scst.org.uk/wp-content/uploads/2024/02/BHRS-standards-January-2024-Implantation-and-Follow-Up-of-CRM-Devices-in-Adults.pdf, 1 November 2024.

2. Leadless cardiac pacemaker implantation for bradyarrhythmias. Interventional procedures guidance [IPG626] Published: 29 August 2018. https://www.nice.org.uk/guidance/ipg626.

3. UK Expert Consensus Statement for the Optimal Use and Clinical Utility of Leadless Pacing Systems on Behalf of the British Heart Rhythm Society. Paul Roberts, Mohamed Hassan El Refai, Paul Foley, Archana Rao, David Sharman, Riyaz Somani, Simon Sporton, Gary Wright, Amir Zaidi, Chris Pepper. Arrhythmia & Electrophysiology Review 2022;11:e19. DOI: https://doi.org/10.15420/aer.2022.17.

Quality standards: NICE guidelines

Quality standards refer to sets of guidelines, systems, methods, requirements, and specifications followed by an organisation to ensure consistent quality. NICOR has adopted a number of quality standards for the NACRM audit and reported on them consistently over a number of years.

The following documents have been used to define the standards for CIED implantation and ablation:

1. Standards for Implantation and Follow-up of Cardiac Rhythm Management Devices in Adults. January 2024. British Heart Rhythm Society. https://bhrs.com/wp-content/uploads/2024/01/BHRS-standards-January-2024-Implantation-and-Follow-Up-of-CRM-Devices-in-Adults.pdf

2. Standards for Interventional Electrophysiology Study and Catheter Ablation in Adults. April 2020. https://bhrs.com/wp-content/uploads/2020/04/British-Heart-Rhythm-Society-Standards-Ablation-2020-1.pdf

3. Dual-chamber pacemakers for symptomatic bradycardia due to sick sinus syndrome without atrioventricular block. National Institute for Health and Care Excellence. 2014. https://www.nice.org.uk/guidance/ta324

4. Implantable cardioverter defibrillators and cardiac resynchronisation therapy for arrhythmias and heart failure. National Institute for Health and Care Excellence. 2014. https://www.nice.org.uk/guidance/ta314

Further information about the quality standards can be found here:

Procedural success and complication rates – CIEDs

Patients and clinicians want successful procedures. Unfortunately, it is inevitable (with current techniques) that some procedures do not go as planned. There are a number of well-recognised complications for CIED procedures. Some of these are captured by the NICOR audit at present, and some are not.

The data we report on re-intervention rates should, therefore, be seen as a surrogate marker of quality. Aside from the fact that we do not capture all complications, it is recognised that re-intervention does not always reflect a complication from the original procedure; for example, a patient may develop an indication for a new CIED, such as a CRT or ICD because of the development of heart failure. Occasionally, there can be technical CIED failure requiring CIED replacement.

CIED Complications

Haematoma

A small haematoma (bruise) post-CIED implantation is common. However, some are large and compromise the integrity of the wound. Sometimes, patients are admitted for observation (this is not captured by NICOR data), and sometimes, wounds need revising (this is captured by NICOR data).

If hospital admission ICD-10 coding data can be captured by NICOR, then it may be possible to count such admissions or delayed discharges for a haematoma, where observation is required, but it is likely that 30-day readmission rates would be more likely to give accurate proxy data for this and other complications.

Pneumothorax

A pneumothorax is a collection of air outside of the lung but within the pleural cavity. Sometimes the amount of air is small, and observation is all that is required. Sometimes the amount of air is large, and pleural aspiration or a pleural drain is required. It typically occurs as a consequence of accessing the subclavian vein when introducing leads but can rarely be caused by lead placement. NICOR, at present, cannot determine if a pneumothorax has been caused by a pacing procedure.

If admission coding data can be captured by NICOR, then it may be possible to count such admissions or delayed discharges for a pneumothorax. It is likely that 30-day readmission rates would be more likely to give accurate proxy data for this and other complications.

Lead Displacement

Lead displacement is probably the most common complication of pacemaker implantation. Atrial leads displace more frequently than ventricular leads. In most cases, this requires lead replacement or repositioning, which should be captured by the NICOR dataset.

Infection

The standard of care for the treatment of CIED-related infection is the removal of the CIED. This will be captured by the NICOR dataset. However, in some situations, the patient is too ill, or the procedure is considered too high risk. These situations will not be captured by the NICOR dataset. If we had access to ICD-10 hospital admission coding data, we may be able to conduct a more in-depth analysis.

Death

Death is rare as a consequence of a CIED procedure but may occasionally occur. It is more likely to reflect the overall condition of the patient. Death commonly occurs near the time of CIED insertion, but most frequently not as a complication of the procedure. We do not routinely collect data on deaths at present, but it would be sensible to add this analysis if the data becomes available.

What constitutes a simple ablation?

Catheter Ablation

Pioneering surgeons in the 1970s and 1980s developed operations that permanently eliminated many arrhythmias by destroying the causative foci or pathways in the heart (ablation). These operations proved that a curative treatment is possible but required major cardiothoracic surgical procedures. Now, many arrhythmias can be treated by catheter ablation, in which steerable thin probes (catheters) are threaded along vessels and guided into the relevant locations within the heart.

Ablation is then performed, creating a small scar most commonly by passing a radiofrequency (RF) electrical current into the tissue, but sometimes by using extreme cold (cryothermy) or other energy sources. Depending on their complexity, catheter ablation procedures can take from one to several hours; patients can usually be discharged the same day or after a single overnight stay. Catheter ablation procedures can be assigned into three groups:

Simple Ablation

These were the first ablation procedures to be developed. Most simple ablations can be performed as a day case without general anaesthesia.

AV Node Ablation (AVNA)

This is the destruction of the electrical junction between the atria and the ventricles. This prevents fast heart rates due to arrhythmias arising in the atria but renders the patient dependent on a permanent pacemaker. AVNA remains useful in patients for whom other treatments have failed, and in others, improves the efficacy of CRT.

Ablation of the slow pathway of the AV Node

This is also known as AV Node Modification. It is curative in the vast majority of patients born with extra connections in the heart that cause arrhythmias known as supraventricular tachycardias (SVTs).

Ablation of Accessory Pathways

SVTs can also be caused by additional (accessory) pathways that connect the atria and the ventricles which are remote from the AV node. Commonly, these cause an appearance on the ECG called pre-excitation, and there is an eponymous syndrome associated with this – Wolff Parkinson White syndrome.

Ablation of the Cavotricuspid Isthmus (CTI)

This is a treatment for the typical form of atrial flutter caused by the rapid circulation of a cardiac impulse within the right atrium.

Complex Atrial Ablation

Apart from typical atrial flutter, the ablation of atrial arrhythmias generally requires a more complex approach, usually with computerised equipment to create a 3-dimensional representation of the atria and the arrhythmia (electroanatomic mapping), and guide and record the placement of ablation lesions. Most complex atrial ablations involve isolating the pulmonary veins to treat atrial fibrillation, and this procedure now accounts for around 40% of all catheter ablation procedures.

Single-shot catheter ablation for AF

Conventionally AF ablation has been done by making a series of small electrical burns using a 'point-by-point' approach. More recently a variety of techniques have been introduced using a shaped catheter or balloon placed in the mouth of each pulmonary vein, which creates a single circumferential burn. These single-shot techniques are dominated by the 'cryo balloon', which produces a scar by freezing. This technique has similar effectiveness and safety profiles for first-time AF ablation cases and has the advantage of being quicker. Single-shot AF ablation using a cryo balloon is becoming more and more common.

Ablation energy sources should be entered under field 3.21 Ablation energy source(s). Pulsed field ablation (PFA) is a newer technique, and is now listed as option 7 under field 3.21.

Complex Ventricular Ablation

Only around 5% of ablations have ventricular targets, which fall into broadly two groups, focal ventricular arrhythmias (where the object is to locate and eliminate a single focus, usually near the pulmonary or aortic valves) and re-entrant ventricular arrhythmias, usually related to scar from prior myocardial infarction or inflammatory conditions. Ventricular ablations require electroanatomic mapping and can be very lengthy and unpredictable, especially for scar-related arrhythmias.

1-year and 2-year ablation re-intervention rates

Simple ablations

This table is reproduced from Table 11, ESC guidelines for the management of patients with SVT (https://doi.org/10.1093/eurheartj/ehz467). It shows the expected rates of complications and recurrences for simple ablations.

Rhythm	Acute success (%)	Recurrence (%)	Complications (%)	Mortality (%)
Focal AT	85	20	1.4[a]	0.1
Cavotricuspid-dependent atrial flutter	95	10	2[b]	0.2
AVNRT	97	2	0.3[c]	0.01
AVRT	92	8	1.5[d]	0.1

Success rates, recurrence, and complications for focal atrial tachycardia and atrioventricular re-entrant tachycardia vary, depending on the location of the focus or pathway, respectively.

[a] Vascular complications, AV block, and pericardial effusion.
[b] Vascular complications, stroke, myocardial infarction, and pericardial effusion.

[c] Vascular complications, AV block, and pericardial effusion.
[d] Vascular complications, AV block, myocardial infarction, pulmonary thromboembolism, and pericardial effusion.

AT = atrial tachycardia; AV = atrioventricular; AVNRT = atrioventricular nodal re-entrant tachycardia; AVRT = atrioventricular re-entrant tachycardia.

Complex atrial ablations

In trials, recurrences of AF occur in 30-40% of patients (1-2). However, even when recurrence occurs, it does not necessarily have the same symptom burden as before an ablation (3), and patients may not need or want a repeat procedure. Nonetheless, repeat ablation seems to result in improved outcomes.(4)

In practice, in the US healthcare system, about 11% of patients having a first-time ablation for AF have a redo procedure within 1 year. (5) This is a lower figure than seen in some clinical trials (17%). (6)

Complex ventricular ablations

It remains uncertain what constitutes a clinically appropriate re-intervention rate, as this metric exhibits significant variability based on the specific type of ventricular ablation procedure performed and the nature of the underlying cardiac pathology associated with the ventricular arrhythmia ablated. Additionally, it is crucial to recognise that multiple considerations influence the decision for re-intervention, extending beyond the mere recurrence of arrhythmia. Consequently, re-intervention rates do not necessarily match recurrence rates.

For instance, the recurrence rate of ventricular arrhythmia following ventricular ablation varies between 30% and 70%, contingent upon the underlying cardiac condition (7-10). Conversely, the published re-intervention rate (11) from an experienced centre indicates a 30% re-intervention rate among patients with structural heart disease.

Operator counts

The report indicates procedures for each operator. A procedure is assigned to each doctor entered as 1st or 2nd scrubbed operator, or as responsible consultant. Thus, each procedure can contribute to the totals for more than one doctor.

Doctors have been identified solely using GMC No and names/registered specialties have been derived from the GMC List of Registered Medical Practitioners (LRMP).

The occasional appearance of unexpected specialties (such as psychiatry) is generally due to the entry of a valid but incorrect GMC No. It is therefore important to ensure this is correct. Blanks may indicate fellows not in formal training posts, staff grades, etc.

Fields contributing to operator counts are:
Scrubbed Operator 1
Scrubbed Operator 2
Consultant Responsible for Procedure Name

Grade: This includes all medical grades. If, for example, there are other professional groups performing procedures (eg. monitor procedure implants), these should be stated here (*6. Non-medical - nurse practitioner, 7. Non-medical – physiologist*).

Medical implant and ablation technology monitoring

For CIEDs, currently implant (generator, lead) serial number is collected (field 3.21, 3.28, 3.36, 3.44, 3.52, 3.6, 3.68, 3.76, 3.84). For ablation, currently no information on catheter technology is collected. The audit will be moving to collecting more compulsory information on Class 2b/3 implants and ablation technology.

Mortality definitions

Individual patient records are requested from the Office on National Statistics which are shared through NHS England. Each year these are requested a few months before analysis, and therefore for the most recently reported year, does not constitute a complete one year follow up.

References:

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6. Piccini JP, Lopes RD, Kong MH, Hasselblad V, Jackson K, Al-Khatib SM. Pulmonary vein isolation for the maintenance of sinus rhythm in patients with atrial fibrillation: a meta-analysis of randomized, controlled trials. *Circ Arrhythm Electrophysiol.* 2009;2:626–633.

7. Zeppenfeld, K., Kimura, Y. & Ebert, M. Mapping and Ablation of Ventricular Tachycardia in Inherited Left Ventricular Cardiomyopathies. *JACC Clin Electrophysiol* (2023).

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9. Dukkipati, S. R. *et al.* Catheter Ablation of Ventricular Tachycardia in Structural Heart Disease: Indications, Strategies, and Outcomes-Part II. *J Am Coll Cardiol* **70**, 2924-2941 (2017).

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11. Garcia Garcia, J. *et al.* Impact of repeat ablation of ventricular tachycardia in patients with structural heart disease. *Europace* **26**, 1–10 (2023).