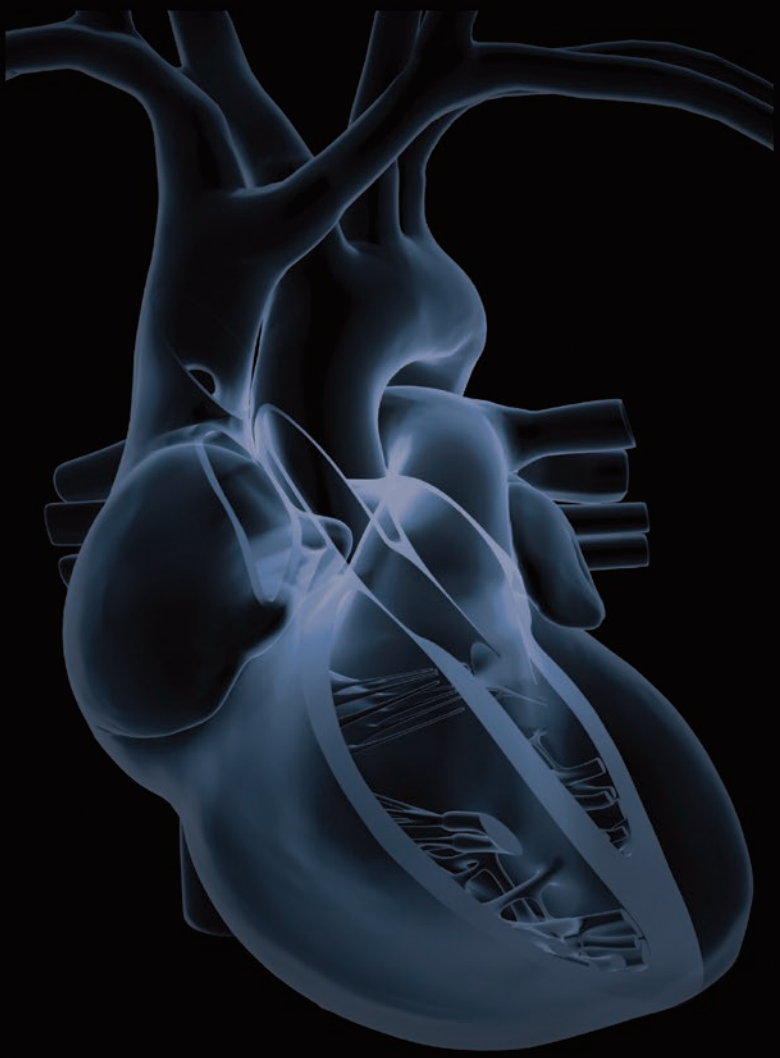
NICOR BCIS HQIP
Healthcare Quality Improvement Partnership



National Audit of Percutaneous Coronary Interventions

Annual Public Report

1 January 2015 - 31 December 2015

NICOR (National Institute for Cardiovascular Outcomes Research) is a partnership of clinicians, IT experts, statisticians, academics and managers which manages six cardiovascular clinical audits and a growing portfolio of new health technology registries, including the UK TAVI registry. NICOR analyses and disseminates information about clinical practice in order to drive up the quality of care and outcomes for patients.

The **British Cardiovascular Intervention Society** promotes education, training and research in cardiovascular intervention and develops and upholds clinical and professional standards.

The **British Cardiovascular Society** is the voice for those working in cardiovascular health, science and disease management in the UK; we aim to promote and support both the healthcare professionals who work in cardiology and the patients for whom we want to encourage the best possible treatment. Our members are healthcare professionals, working in the field of cardiovascular health.

The National Audit of Percutaneous Coronary Interventions is commissioned by the **Healthcare Quality Improvement Partnership (HQIP)** as part of the National Clinical Audit Programme (NCAP). HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing and National Voices. Its aim is to promote quality improvement, and in particular to increase the impact that clinical audit has on healthcare quality in England and Wales. HQIP holds the contract to manage and develop the NCA Programme, comprising more than 30 clinical audits that cover care provided to people with a wide range of medical, surgical and mental health conditions. The programme is funded by NHS England, the Welsh Government and, with some individual audits, also funded by the Health Department of the Scottish Government, DHSSPS Northern Ireland and the Channel Islands.

Founded in 1826, **UCL (University College London)** was the first English university established after Oxford and Cambridge, the first to admit students regardless of race, class, religion or gender, and the first to provide systematic teaching of law, architecture and medicine. It is among the world's top universities, as reflected by performance in a range of international rankings and tables. UCL currently has 24,000 students from almost 140 countries, and more than 9,500 employees. Its annual income is over £800 million.

Acknowledgments

The National Audit of Percutaneous Coronary Interventions is clinically led by the British Cardiovascular Intervention Society (BCIS) and is managed by the National Institute for Cardiovascular Outcomes Research (NICOR) based at University College London (UCL). The audit is commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP).

Looking ahead, NICOR is delighted to announce that following a Europe-wide tender process, Bart's Health NHS Trust (Bart's Health) has been awarded the contract for NICOR to continue to manage the National Cardiac Audit Programme from 1st July 2017 to 30th June 2022. This includes the National Adult Percutaneous Interventions Audit.

Therefore from 1st July 2017, NICOR will transfer from the University College London to Bart's Health.

We would like to thank the contribution of all NHS percutaneous coronary intervention centres in Scotland, Wales and Northern Ireland, UK private hospitals and the individual nurses, clinicians and audit teams who collect data and participate in the audit. Without this input the audit could not continue to produce credible analysis, or to effectively monitor and assess the standard of PCI procedures in the United Kingdom.

The report was produced by:

Dr Peter F Ludman MA MD FRCP FESC
Queen Elizabeth Hospital, Birmingham
Audit Lead for the British Cardiovascular Intervention Society (BCIS)

Anthony Bradley
Acting NAPCI Project Manager
National Institute for Cardiovascular Outcomes Research

In collaboration with:
Eric Topham – Data analyst, NICOR
Sue Manuel – Developer, NICOR

This report is available online at http://www.ucl.ac.uk/nicor/audits/adultpercutaneous/reports. A full version of the analyses is available for download from the BCIS website (www.BCIS.org.uk).

National Audit of Percutaneous Coronary Interventions
National Institute for Cardiovascular Outcomes Research (NICOR)
Institute of Cardiovascular Science, University College London
2nd Floor, 1 St Martin's le Grand, London, EC1A 4NP

For general enquiries about this report please call:
Tel: 020 765 8549
Email: aci-nicor@ucl.ac.uk

Published 14 September 2017.

National Audit of Percutaneous Coronary Interventions

1 January 2015 - 31 December 2015

This is a report of the National Audit of Percutaneous Coronary Interventions (NAPCI). It has been produced specifically for anyone who wants to know more about the use of PCI procedures to treat angina and acute coronary syndromes including the treatment of heart attacks. It is written for people with little or no previous knowledge of PCI procedures, clinical conditions or clinical audit.

It is an abbreviated version of the United Kingdom's National Audit of Percutaneous Coronary Intervention. The full report is available for download at www.BCIS.org.uk.

All words in **green** are included in the glossary at the end of the report

Contents

List of figures and tables

Executive summary

The audit of percutaneous coronary intervention (PCI) is a continuous audit that collects information about all percutaneous coronary intervention procedures performed in all NHS hospitals and the majority of private hospitals in the UK.

The audit shows a reassuring picture of PCI quality in the UK. Over the last 4 years percutaneous coronary intervention (PCI) activity in the UK has matured, as the proportion of differing clinical syndromes (case mix) treated has stabilised. From 2014 to 2015 there was only a 0.5% increase in total PCI activity, bringing the total to 97,376 procedures which represents a rate of 1,496 per million population (pmp). The percentage of patients treated for an acute coronary syndrome has levelled off at about 65%, though with variance between centres. It is a great benefit for patient care that primary PCI is established across most of the UK as the default treatment for ST elevation MI and represents about 27% of all PCI activity. For most regions in the UK this represents a rate of between 300 and 500 pmp. There are 69 PCI hospitals in the UK to whom ambulances bring patients with STEMI to be treated by primary PCI.

Case ascertainment and data quality have improved but some centres stand out as not meeting the minimum data standards. This is particularly an issue for patients being treated in the context of an acute coronary syndrome. Some participating hospitals need to improve their compliance with the national audit project. Hospitals should also ensure they use the nationally agreed variable definitions when completing the datasets.

I. Low volume PCI hospitals

There are a number of NHS and private centres that do not conform to the national guidance of performing a minimum of 400 PCIs per annum[1]

II. Urgent and Emergency PCI

Most centres achieve satisfactory 'door to balloon' times for the emergency treatment of STEMI (91% of patients treated within 90 minutes). There is evidence that some centres have improved whilst for others there is definite room for improvement.

The timeliness of treatment of patients with NSTEMI is much less good. While there is no evidence that this leads to adverse outcomes, it does increase the time a patient has to spend in hospitals unnecessarily, and therefore also increases treatment costs. The median delay from admission to treatment is 69 hours. NICE recommends treatment within 72 hours (see '1.3 Guidelines and quality standards' in main report below), yet only 57% of patients received treatment within the guideline time frame. Delays were worse for patients who have to be transferred from another hospital for their PCI. There is also considerable variation between centres – those with poor times could learn from centres that provide a more rapid service.

III. Out of hospital cardiac arrest

The optimal management of patients who are successfully resuscitated following cardiopulmonary arrest in the community remains uncertain. Guidelines recommend that patients be considered for emergency or urgent angiography and PCI where appropriate. The PCI audit dataset was enlarged to try to capture more information about these patients and the initial results are presented in this audit. About half of all patients treated by PCI having sustained an out of hospital arrest are self-ventilating by the time they arrive in the catheter lab. The other half needed mechanical ventilatory support, and this amounted to a total of 1,495 patients in 2015. The majority of these patients presented with ST elevation on their post cardioversion ECG. There was however enormous variability between PCI centres, with these cases representing more than 5% of all PCI activity for some, and almost 0% for others. This suggests that some centres may be denying patients treatment that might improve outcomes, and others may be offering treatment where it might be futile. Although the variation probably reflects differences in protocol driven investigations for these patients, international guidance supports the treatment of a subset of these patients and all centres need to develop clinical protocols. Network protocols to enable rapid treatment in the community (before a patient gets to hospital) are also likely to improve outcomes.

IV. Radial arterial access

PCI using radial access rather than the traditional femoral artery access is associated with reduced complications in both observational datasets and randomised trials. PCI operators in the UK have continued to improve their practice by switching to using the radial artery as the default strategy, and in 2015 radial access was used in 80.5% of all procedures; there have been continuous increases in the use of this technique over the last few years. Operators and centres with low radial access rates should review practice.

V. Conformance with data completeness

There have been year-on-year improvements in conformance with the data completeness of key fields but there are still a number of hospitals where the quality of the data received is sub-optimal.

Every year the audit produces an extensive list of analyses relating to various quality indicators and recommendations for a good practice with a comparative data for the participating hospitals as well as comparisons amongst the UK countries. **The full list of analyses can be found on the BCIS web site[2].**

1. http://heart.bmj.com/content/101/Suppl_3/1.full
2. www.bcis.org.uk

Recommendations

I. Commissioners and provider Chief Executives

We recommend that:

1. PCI activity at individual hospitals reaches the minimum of 400 procedures per year.
2. PCI centres, Strategic Clinical networks and Commissioners work to improve treatment times for patients receiving urgent and emergency care, especially when an inter-hospital transfer is required.
3. Current service configuration is reviewed for emergency cases with ST elevation MI (a) in hospitals that perform less well than the centres who provide the fastest treatment and (b) for patients where transfer between hospitals is involved.
4. A review of the clinical pathways for patients with NSTEMI undergoing PCI is undertaken to ensure patients receive timely treatment. This is especially important for those who have to be transferred from one hospital to another for treatment.
5. There are sufficient resources allocated to support national clinical audit activity.

II. Medical directors and clinical leads

We recommend that:

6. Hospitals review their use of radial artery access for PCI and plan the appropriate training to ensure this route is used as the default access route whenever possible.
7. All PCI centres provide appropriate support to the clinical audit teams. Our data show that a higher level of clinical engagement with the clinical audit team is associated with better data completeness and data quality. Each clinical audit should have a dedicated clinical lead assigned to support this activity.
8. All operators engage with the national audit programme and their local clinical audit team and to ensure timely submission of accurate data to NICOR.
9. All operators regularly review their outcomes via the NICOR PCI Operator Outcomes tool for their in-hospital complication rates and other relevant clinical measures.
10. Clinical and audit teams comply with completion of the new dataset items on cardiac arrest and new stent technology fields in addition to the existing data fields.

III. Clinical audit teams

Everyone who is responsible or in some way involved in PCI audit data collection and submission should:

11. Submit their data regularly, at least on a quarterly basis. More contemporaneous data allow more relevant analyses.
12. Check that the data submitted to NICOR are accurate and that the reports on your data are consistent with your submitted data; this is especially relevant to those hospitals that use third party software for data submission.
13. Engage with the reports that are sent to the hospitals on a quarterly basis to check case ascertainment rates and data completeness especially for fields defined in the NICOR Minimum Data Standard. Data completeness should be at a minimum level of 95% but as high as possible.
14. Regularly review the audit reports sent to the hospital by the NAPCI team to ensure the hospital's performance meets NICE quality standards and recommendations for good practice (see section 1.4 of this report).

1 Introduction

1.1 Coronary heart disease

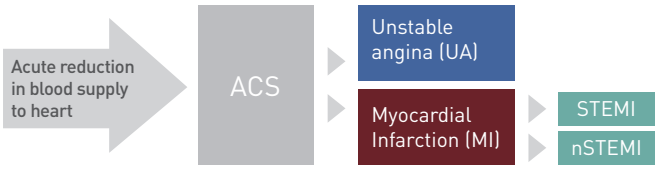
Coronary heart disease (CHD) is the largest cause of death and disability in the United Kingdom. CHD causes around 73,000[3] deaths in the UK each year and around one in five men and one in seven women will die from the disease.

Coronary heart disease is usually caused by **atherosclerosis** which is a process where the walls of the arteries develop fatty deposits called atheroma. Atherosclerosis manifests itself in a number of conditions of which the two conditions below are relevant to this audit:

Stable angina is a symptom that occurs when the artery becomes progressively narrowed and blood supply to the heart muscle will become restricted. People experience a tight constricting feeling, normally across the chest. It is brought on by physical exertion or stress. Stable angina is a chronic medical condition with a low but appreciable incidence of **acute coronary events** and increased mortality.

Acute Coronary Syndromes (ACS) occur when there is a sudden or recent reduction in the blood supply to the heart and include **unstable angina** and myocardial infarction (**heart attacks**); Figure 1a. The symptoms for both unstable angina and a myocardial infarction can be similar (for example, chest pain or tightness, breathlessness and sweating) but these syndromes can be distinguished with an **electrocardiogram (ECG)** and blood tests.

Figure 1a: Types of acute coronary syndrome



A myocardial infarction (heart attack) occurs when a coronary artery becomes totally blocked by a clot (thrombus) which forms over the fatty deposits in the wall of the artery. If the blockage persists the region of the heart muscle supplied by that artery will progressively die (myocardial necrosis). This syndrome is referred to as ST elevation myocardial infarction (STEMI), because usually this pattern (elevation of the ST segments) is seen on the ECG.

Sometimes the shortage of blood supply to the affected heart muscle is less severe or intermittent and may not lead to death of heart muscle cells (in other words there is no myocardial necrosis). If there is no necrosis then the syndrome is called unstable angina. If there is evidence of some myocardial necrosis without ST segment elevation it is referred to as non ST elevation myocardial infarction (nSTEMI).

1.2 Percutaneous coronary procedures

Percutaneous Coronary Intervention is one of two coronary **revascularisation** techniques used to treat narrowed arteries, the other being **coronary artery bypass grafting** (CABG).

The PCI procedure works by mechanically improving blood flow to the heart and it is less invasive than the coronary artery bypass grafting. During the procedure, a small balloon is inserted which, when inflated, widens the artery. In most cases a 'stent' – metal mesh scaffold – is implanted to keep the artery wall open.

3. http://www.nhs.uk/Conditions/Coronary-heart-disease/Pages/Introduction.aspx

1.3 Guidelines and quality standards

The National Institute for Health and Clinical Excellence (NICE) recommends that PCI is used to manage stable angina[4 5] and acute coronary syndromes[6 7] in three ways:

- Alleviate the symptoms of angina.
- Restore coronary blood flow during a heart attack (**primary PCI**).
- Prevent future myocardial infarction.

To achieve this NICE have published the following statements:

Quality	Detail
NICE quality standard [QS68] – Quality statement 3	Coronary **angiography** and PCI is performed within 72 hours for patients with NSTEMI or unstable angina.
NICE quality standard [QS68] – Quality statement 4	Coronary angiography and PCI for adults with NSTEMI or unstable angina who are clinically unstable as soon as possible or within 24 hours from becoming clinically unstable.
NICE quality standard [QS68] – Quality statement 5	Adults who are unconscious after cardiac arrest caused by suspected acute **ST segment elevation myocardial infarction (STEMI)** are not excluded from having coronary angiography (with follow–on primary percutaneous coronary intervention [PCI] if indicated).
NICE technology appraisal guidance 71 – Sections 1.1 and 1.5	Drug-eluting stents for the treatment of coronary artery disease where indicated for patients with small arteries and long lesions.

In addition to NICE guidelines, the British Cardiovascular Intervention Society has published updated recommendations for good practice in 2015[8] of which key recommendations are:

Recommendation	Detail
Institutional facilities	Each **PCI hospital** undertaking emergency PCI cases should have at least two cardiac dedicated catheter laboratories.
Institutional volume	Minimum case volume for a PCI hospital is 400 procedures per year. Minimum of three interventional cardiologists per hospital. Hospitals providing a primary PCI service should perform a minimum of 100 PPCI procedures each year.
Operators volume of cases	Every operator should perform a minimum of 150 cases within a two year period. Operators performing primary PCI procedures should undertake a minimum of 50 elective or emergency cases per year within the primary PCI hospital.
Monitoring institutional standards	All PCI hospitals are expected to collect comprehensive and accurate data that relate to the interventional treatment they provide for their patients. Regular departmental discussions should include individual case presentations for all unexpected mortality and morbidity. BCIS will provide operators with a detailed breakdown of their own PCI activity that includes **risk-adjusted** outcome analysis.

Other standards/recommendations	Detail
Data from a number of randomized trials and multiple registries[9]	There is increasing evidence that arterial access via the radial route is associated with a reduction in bleeding complications.

4. https://www.nice.org.uk/guidance/cg126/chapter/guidance#investigation-and-revascularisation
5. https://www.nice.org.uk/guidance/qs21
6. https://www.nice.org.uk/guidance/cg167/chapter/recommendations
7. http://www.nice.org.uk/guidance/QS68
8. http://heart.bmj.com/content/101/Suppl_3/1.abstract?etoc
9. J Am Coll Cardiol. 2014;63(10):973-975. doi:10.1016/j.jacc.2013.09.066

1.4 National Audit of Percutaneous Coronary Interventions (NAPCI)

1.4.1 The role of the audit

Clinical audit is the process of monitoring the care and treatment of patients against agreed national and international standards with a view to driving up the quality of care and improving outcomes for patients. The British Cardiovascular Interventional Society (BCIS) has continuously audited PCI activity since 1988 and in collaboration with NICOR since 2006. The audit has collected patient level data nationwide since about 2005. The audit provides information on the:

- Structure of the provision of PCI services across the UK (for example the number of PCI centres and their coverage, number of PCI procedures per centre and population, number of operators in each centre etc).
- Appropriateness of clinical care and treatment provided by each hospital, measured against national aggregated data and agreed national standards (for example. indication for treatment, use of stents, arterial access routes).
- Process of care (for example delays in receiving treatments such as primary PCI).
- Outcome for patients such as complications, adverse cardiac events and death/survival.

1.4.2 Project governance

The audit is managed by the National Institute of Cardiovascular Outcomes Research (based at University College London) and is clinically led by the British Cardiovascular Intervention Society.

The British Cardiovascular Interventional Society provides intellectual and clinical leadership of the audit. In 2014 the BCIS Data Monitoring and Audit Group has expanded its membership to include patient representatives, participating hospitals and representatives from the MHRA, a regulatory body. The audit is referred to as the National Audit of Percutaneous Coronary Interventions (NAPCI).The Steering Group meets three times a year (see appendix 4 for its membership).

The Steering Group's remit is to:

- Provide leadership on the aims and delivery of the project, dependent on allocation of resources, in collaboration with the British Cardiovascular Intervention Society and to ensure the agreed reports are published.
- Ensure that the project is aligned with the evolving needs within the clinical specialty.
- Review the UK wide audit data to assess whether hospitals and operators are meeting the evidence based standards. The BCIS has an **Outlier** Policy which is followed when the results suggest a centre or operator is not meeting those standards.
- Review applications to use the audit data for research or other quality improvement programmes outside of NICOR.
- Review the dataset for potential changes to ensure it remains up to date in the context of an evolving evidence base.

The NAPCI audit is commissioned by the Healthcare Quality Improvement Partnership (HQIP). HQIP holds commissioning and funding responsibility for this and several other national clinical audits.

1.4.3 Methodology

NAPCI is a continuous audit and collects information about all percutaneous coronary intervention procedures performed in all NHS hospitals and the majority of private hospitals (more information about the participation can be found in section 2.1) in the UK (England, Wales, Scotland and Northern Ireland). The data are collected at the hospital level, including in the instances where more than one participating hospital is part of the same Trust or Welsh Heath Board.

In addition to percutaneous coronary intervention (deemed to have taken place if any coronary device such as a guide wire approaches, probes or crosses one or more coronary lesions, with the intention of performing a coronary intervention), the audit also collects information about the use of diagnostic interventional procedures such as pressure wire measurement, or the use of intracoronary imaging where no PCI ensues. There have been concerns about the overuse of PCI in patients with stable coronary disease. Trial results[10] have shown improved outcomes with appropriate use of adjunctive technologies such as pressure wire assessment of lesions and the use of intravascular ultrasound.

Data can be either entered manually via a dedicated interface (web-based application) or imported from existing hospital clinical information systems using commercial or locally developed software. All data uploaded by hospitals are encrypted on transmission and stored encrypted on the NICOR servers. NICOR manages access control to the servers via user ID and password.

In addition to clinical data, the audit also collects patient identifiable information to allow for the datasets to be linked with external datasets such as the Office for National Statistics for mortality analysis. NICOR has permission from the Confidentiality Advisory Group[11] to collect and store this information without patient consent.

10. http://eurheartj.oxfordjournals.org/content/ehj/35/37/2541.full.pdf

11. http://www.hra.nhs.uk/research-community/applying-for-approvals/confidentiality-advisory-group-cag/

Data held within NICOR are managed within a secure environment for storage and processing provided by the UCL network and within the UCL Information Governance and security policies. In addition, NICOR staff recognise that confidentiality is an obligation and regularly undergo information governance training to ensure understanding of the duty of confidentiality, how it relates to patient information and the data that are held and handled at NICOR.

1.4.4 Data quality, data completeness & case ascertainment

External data validation is not possible. We intend to explore the suitability of HES data in this regard. Currently, case ascertainment rates are based on the self-reported data via an annual survey that requests information about total number of cases performed. Each participating hospital is also encouraged to undertake a systematic validation of case ascertainment rates, data completeness and the quality of data that they submit to NICOR. Hospitals are sent automated reports from NICOR on a quarterly and monthly basis that provides feedback on data completeness as well as aggregate data of relevant clinical indicators.

In addition, the audit has defined a minimum data standard[12] that comprises those fields most important in the analysis of key quality indicators and the analysis of risk adjusted outcomes. Hospitals are required to meet a minimum of 95% data completeness for these fields. The results of data completeness for the fields in question are available in appendix 2.

1.4.5 How we analysed the data

Data held within the secure storage environment at NICOR were extracted and provided to the information analyst. Because the analyst did not need to access personal identifiers for this work, personal identifiers in these data were replaced with codes prior to distribution.

The data provided by hospitals do not always adhere to the technical standards of the audit. The data are first processed to reduce the effect of deviation from the audit's standards and to maximise their usability for analysis. Analysis proceeds on cleaned data.

The data cleaning and analysis processes described in this report were performed in the R statistical programming language (version 3.2.2, released on 14 August 2015). R is the sixth most popular programming language in the world, well above its competitors Matlab (ranked 10th) and SAS (26th). NICOR's Analysis Team standardised around the use of R across all national audit work in 2011. The PCI audit benefits from this standardisation as code snippets, data structures and analysis frameworks are shared among team members, resulting in more sophisticated analysis and presentation in shorter time frames.

The PCI data cleaning and analysis processes use the R package pmgr. Data that do not fit the standards for each field are transformed when possible to make them usable for analysis. On rare occasions, multiple copies of records for the same procedure are found to be duplicated and so stored twice or more in the database. Duplicate records are identified and removed prior to analysis.

Most of the analyses available in this report are descriptive statistics. They are calculated using standard modules within the R programming framework. Tables and graphics are also prepared within R, and then exported for inclusion in this report. Funnel plot methodology is used to determine whether results from individual centres are within agreed boundaries. A more detailed explanation about the statistical methodology is available on request.

12. http://www.ucl.ac.uk/nicor/audits/adultpercutaneous/datasets

2 Findings

2.1 PCI activity and structure

The optimal rate of PCI per million population (pmp) is difficult to judge and is dependent on many factors, including the varying characteristics of populations in different countries. While the rate of PCI pmp in the UK has, historically, been considerably lower than most other European countries, there have been steady increases in activity. A total of 97,376 PCIs were performed from January to December 2015 compared with 96,143 in 2014.This represents rate of 1,496 PCI pmp in 2015 compared to 1,488 pmp in 2014 (see Figure 1 for temporal trends). There is variation in the rate of CI across the different regions of the United Kingdom.

Figure 1: Temporal trends of PCI numbers and per million population rates

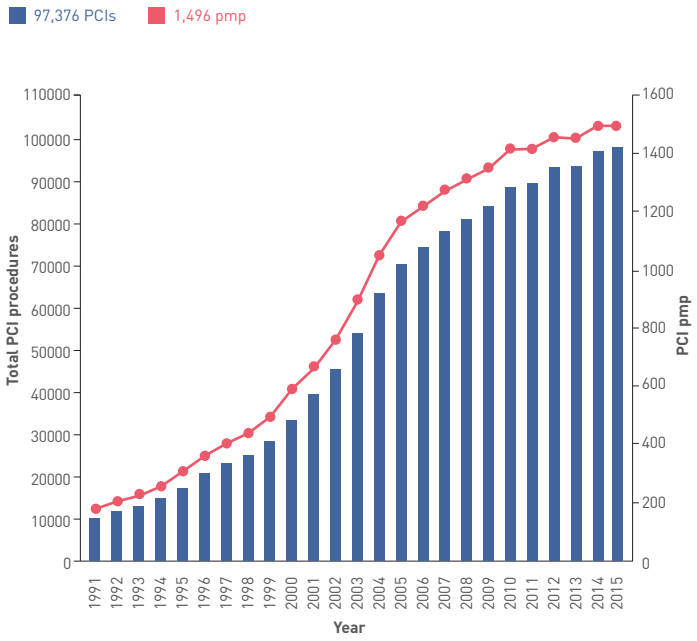
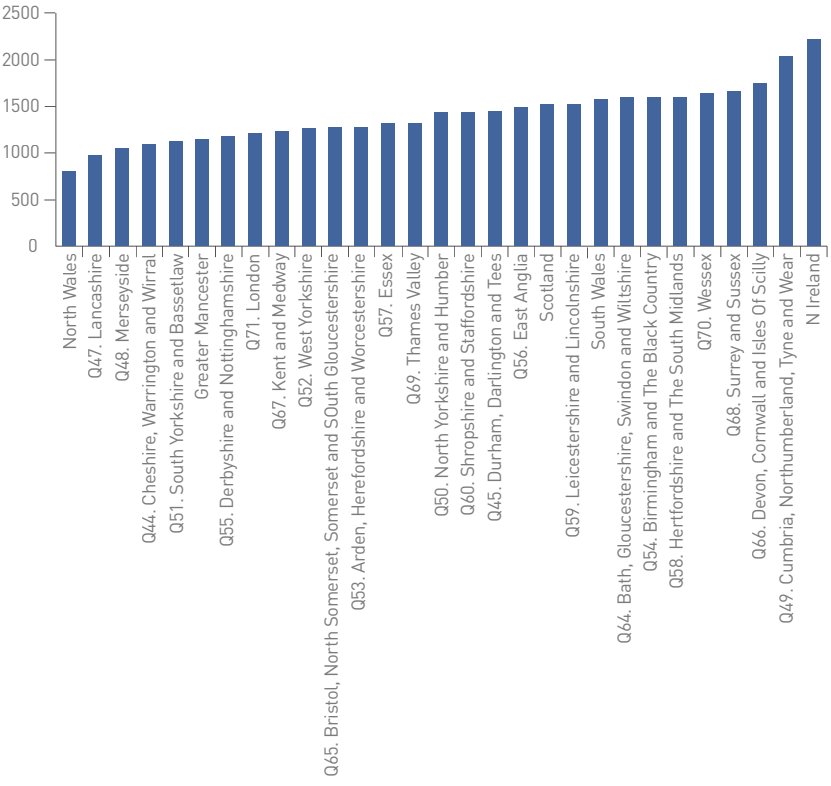


Figure 2a: Rate of PCI pmp by local area team (LAT) and UK country



Primary PCI is established across most of the UK as the default treatment for ST elevation MI and represents about 27% of all PCI activity (see Figure 2), and for most regions in the UK represents a rate of between 300 and 500 pmp (Figures 3 & 4) which is comparable to the rates in other European countries[13]. There are 69 PCI centres in the UK to whom ambulances bring patients with STEMI to be treated by primary PCI.

Figure 2: Proportion of different indications for PCIs performed each year

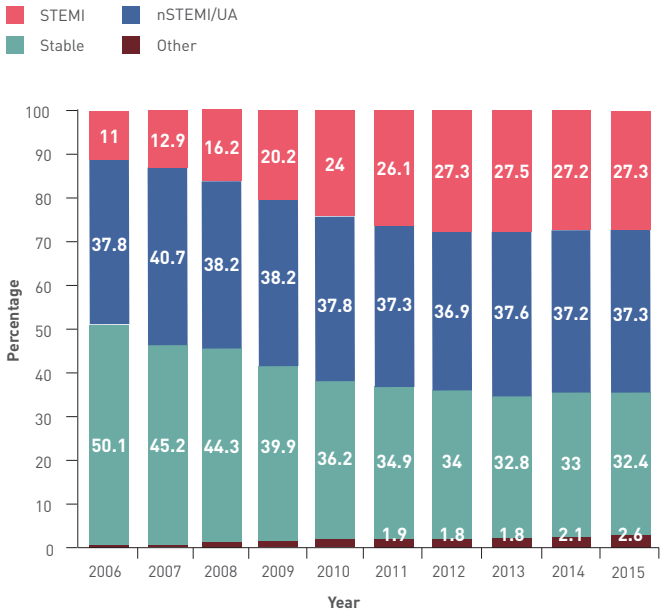
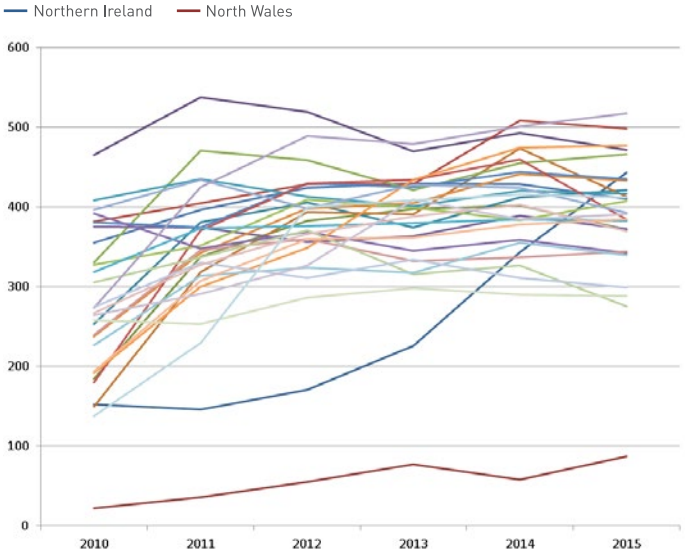


Figure 3: Rate of primary PCI pmp by each Local Area Network and UK country over the last 5 years



13. Eur Heart J. 2014 Aug 1;35(29):1957-70. doi: 10.1093/eurheartj/eht529. Epub 2014 Jan 12.

Figure 4: Rate of primary PCI pmp by each Local Area Network and UK country in 2015

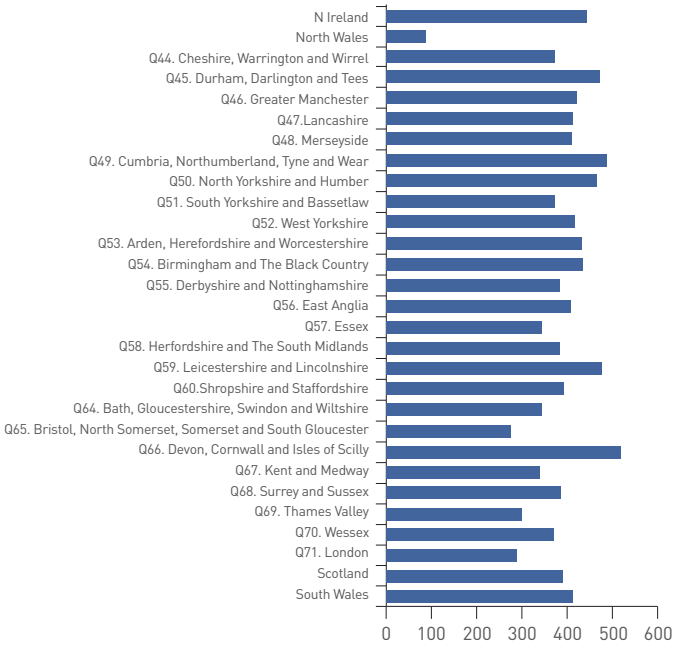
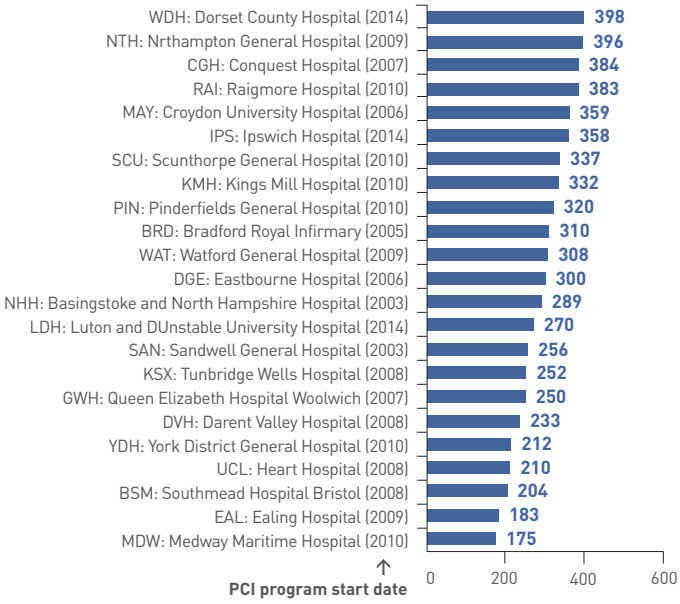


Figure 5: Hospitals that performed less than 400 PCIs in 2014 with a year the PCI activity started



There is evidence that patients treated in higher volume centres may have improved outcomes, particularly centres that perform at least 400 procedures per year. The BCIS and BCS 'Recommendations for good practice and training'[14] recommend that centres undertake at least 400 PCI procedures each year. In 2015, 23 NHS PCI centres performed 400 or fewer cases. Nevertheless all but 2 NHS centres performed over 200 cases (Figure 5). Centres that perform less than 400 procedures per year are encouraged to increase their level of activity to a minimum of 400 procedures; whilst those that perform less than 200 procedures per year should have a robust plan in place to show how this standard can be achieved in the future.

BCIS also recommends that every operator should perform a minimum of 150 cases within a two year period. The information about the individual operator PCI activity is available on the BCIS web site (www.BCIS.org.uk).

There are several possible reasons why operators may be recorded with a low procedural volume. It may genuinely reflect their practice. They may have only been appointed as a consultant part way through the year in question. They may have suspended their work for personal reasons such as pregnancy, or by taking a sabbatical.

14. http://heart.bmj.com/content/101/Suppl_3/1.full

2.2 Patient demographics

Patients that are treated by PCI have a mean age of 65 on average, 75% are male. Female patients treated with PCI tend to be slightly older with an average age of 69 years.

Patient outcomes are often influenced by other factors in addition to the care provided and some of those characteristics are presented in Table 1. Smoking is one of the risk factors that affect patient outcomes. The British Heart Foundation reports that smokers are almost twice as likely to have a heart attack compared with those that never smoked as smoking damages the lining of the arteries predisposing to the build-up of atheroma resulting in narrowed arteries and also increases the likelihood of blood clotting in the arteries. There appears to be only a very a small reduction in the patients who are current smokers.

The rate of patients who have previously had PCI is steadily increasing as this treatment becomes more prevalent. The rate of patients with diabetes has also increased over the last few years.

Table 1: Summary of patient demographics between 2007 and 2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Age (mean)	63.6	63.8	64.2	64.3	64.6	64.8	64.9	65.1	65.1
Sex (male)	73.8 %	74 %	74.1 %	74.2 %	74.1 %	74.1 %	74.2 %	74.3 %	74.5
Diabetic	17.5 %	18.2 %	18.3 %	18.7 %	19.1 %	20.2 %	20.8 %	21 %	22.0
Previous CABG	8.6 %	9.2 %	8.7 %	8.6 %	8 %	8.3 %	8.6 %	8.4 %	8.4
Previous PCI	18.4 %	20.6 %	21.7 %	22 %	22.7 %	23.5 %	24.7 %	25.6 %	26.4
Previous MI	29.6 %	30.1 %	28.8 %	28.2 %	27.6 %	26.8 %	27.3 %	27.4 %	27.5
Current smoker	24 %	24.2 %	25.9 %	26.4 %	26.1 %	25.4 %	25.2 %	24.4 %	24.0
Ex-smoker	40.1 %	40.7 %	40 %	38.7 %	37.1 %	36.8 %	37.7 %	37.3 %	37.9
Never smoked	35.8 %	35 %	34.1 %	34.9 %	36.8 %	37.8 %	37.1 %	38.2 %	38.1

2.3 Clinical practice

2.3.1 Urgent and emergency procedures

Emergency procedures are procedures performed as soon as possible after the patient becomes ill, at any time of day or night. Urgent procedures are those that are necessary during the current period of hospitalisation, but are not needed immediately. Urgent or emergency treatment is usually required for patients who present with an acute coronary syndrome (see Table 2).

Table 2: A description of the different types of acute coronary syndrome

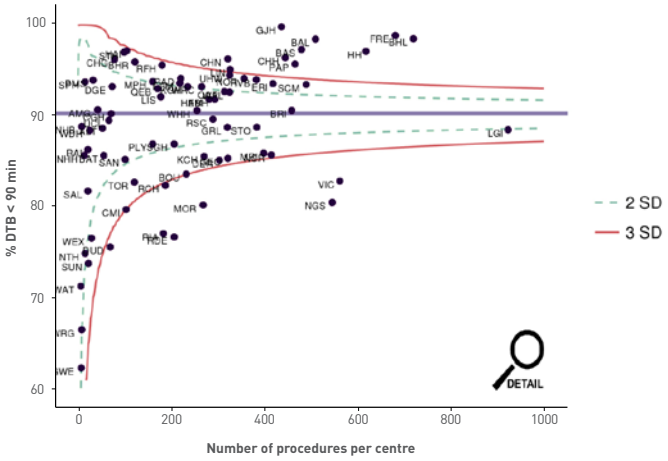
Acute coronary syndrome	ST segment elevation (STEMI)	ST-elevation usually indicates complete blockage of a coronary artery and, in most cases, warrants immediate (emergency) treatment to re-open the artery. Also commonly known as heart attack.
	Non-ST segment elevation (nSTEMI)	nSTEMI is another type of a heart attack but usually there is only partial occlusion of the coronary artery. Treatment with PCI is not usually needed immediately but can be performed over the next few days.
	Unstable Angina	When there is a rapid reduction in blood flow to the heart muscle, but this does not cause any muscle cells to die (i.e. in spite of changes to blood flow there is no myocardial necrosis), then the condition is described as unstable angina.

Patients with STEMI

Patients with STEMI are treated by an emergency procedure called primary PCI. NICE guidelines[15] recommend that patients receive primary PCI within 90 minutes from arrival at the PCI hospital. This is measured as the **door-to-balloon time (DTB)**. In 2015 the average percentage of patients being treated within 90 minutes from arrival at a PCI hospital was 90.9 % (see Figures 6).

15. https://www.nice.org.uk/guidance/QS68/chapter/Quality-statement-6-Primary-PCI-for-acute-STEMI

Figure 6: Percentage of patients who received primary PCI within 90 minutes from arrival at the PCI hospital. The blue line in the middle represents the national average which is 90.9%. (See appendix 1 for hospital codes and their corresponding names.)



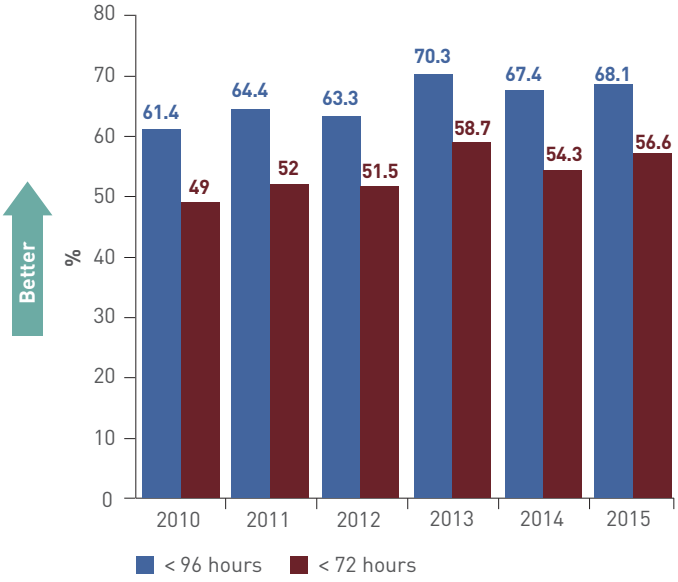
While the overall performance is good, there is evidence of quite a range of rapidity of treatment. Some of this variability reflects different logistic arrangements. For example, patients are treated more rapidly if they bypass A&E departments, and are brought directly to the cardiac catheter lab by paramedics. However for centres with A&E departments, a proportion of their patients will self-present to A&E, and this often adds delay. Even with these factors taken into account this analysis suggests that there is room for improvement for a considerable number of hospitals. Comparing the UK countries, Scottish patients were treated the most quickly (93% within 90 min), then Northern Ireland at 90%, England at 89% and finally Wales at 88%.

Patients with nSTEMI/unstable angina

Coronary angiography is a diagnostic procedure that is important in determining the extent and severity of the coronary disease. NICE guidelines[16] published in September 2014, recommend that once a diagnosis of NSTEMI is made, coronary angiography should be offered, when appropriate, within 72 hours of first admission. This may lead to revascularisation by either PCI or CABG. This guidance specifically relates to patients who have an intermediate or higher risk of adverse cardiovascular events as predicted by the GRACE score[17]. The audit tracks patients with UA/NSTEMI who end up being treated by PCI.

Figure 7 shows that only the average percentage of patients treated by PCI within the previous 96 hour target, and the revised guidelines of 72 hours. It can be seen that in 2015 only 56.6% of patients received angiography and PCI within 72 hours.

Figure 7: Percentage of patients with nSTEMI that received PCI within 96 hours compared with 72 hours from the time of admission to the first hospital with temporal trends over the last five years

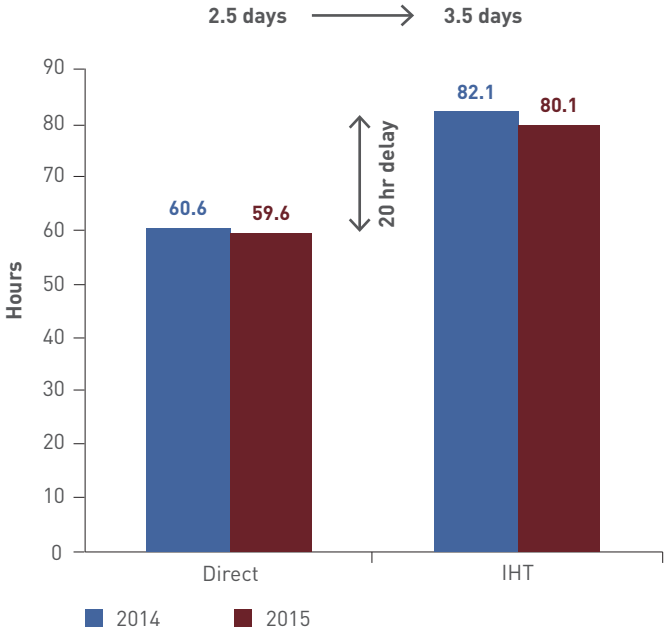


16. https://www.nice.org.uk/guidance/QS68/chapter/Quality-statement-3-Coronary-angiography-and-PCI-within-72-hours-for-NSTEMI-or-unstable-angina

17. http://www.gracescore.org/WebSite/About.aspx

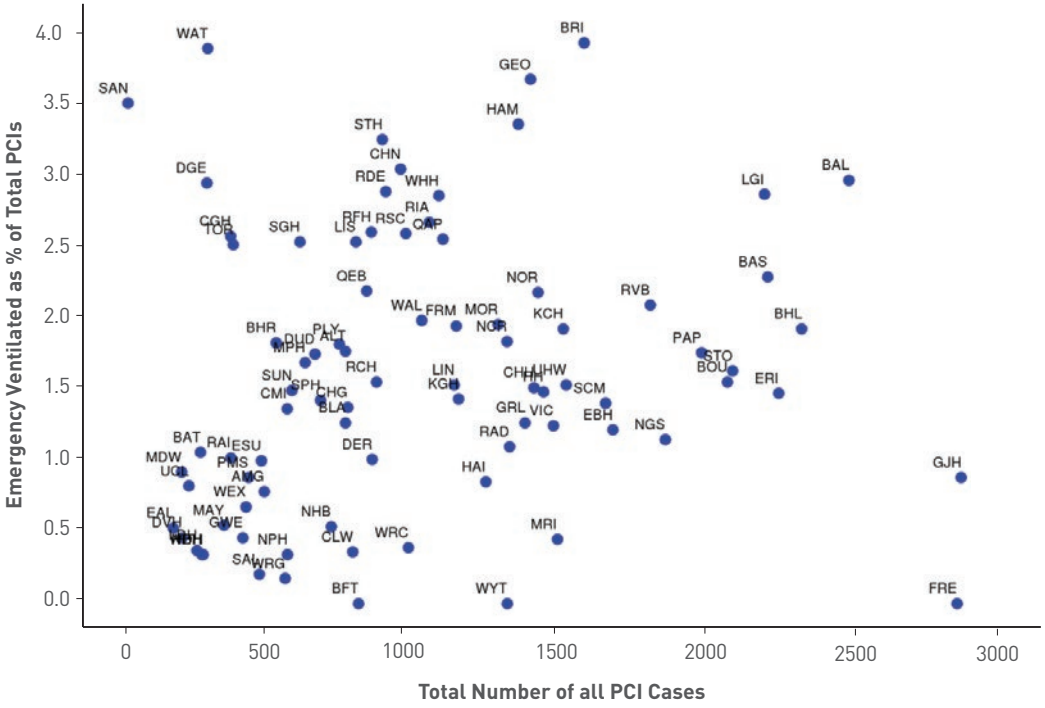
Patients who have to be transferred from another hospital to the PCI centre experience longer delays than those admitted directly to a PCI centre, with the average difference approaching one day (figure 8).

Figure 8: Time delays between first admission to hospital and angiography with PCI in 2014 and 2015. Direct refers to patients who were admitted to a PCI centre and IHT refers to those who are initially admitted to a hospital without PCI facilities and are then transferred to a PCI centre



2.3.2 Out of hospital cardiac arrest

Figure 9: Percentage of patients who were ventilated before the PCI procedure (the majority of these are patients who have sustained out of hospital cardiac arrest). (See appendix 1 for hospital codes and their corresponding names.)



The optimal management of patients who are successfully resuscitated following cardiopulmonary arrest in the community remains uncertain. The PCI audit dataset was enlarged to try to capture more information about these patients and the initial results are presented in this audit. About half of all patients treated by PCI having sustained an out of hospital arrest are self-ventilating by the time they arrive in the catheter lab. The other half needed mechanical ventilatory support and this amounted to a total of 1495 patients in 2015. The majority of these patients presented with ST elevation on their post **cardioversion** ECG. There was however enormous variability between PCI hospitals, with these cases representing more than 5% of all PCI activity for some, and almost 0% for others (Figure 9). Although this probably reflects variation in protocol driven investigations for these patients, international guidance supports the treatment of these patients and all centres need to develop clinical protocols.

2.3.3 Radial arterial access

When performing coronary intervention, catheters are introduced to a patient's arterial system so the coronary arteries can be reached and treated. During the development of PCI techniques the large femoral artery (at the top of the leg) was used. However, some of the commonest complications after PCI relate to the difficulty in stopping this artery from bleeding after removing the catheter at the end of the procedure. PCI equipment has become smaller and so it is now possible to perform almost all PCI from the smaller radial artery in the wrist. PCI using radial access rather than the traditional femoral artery access is associated with reduced complications in both observational datasets and randomised trials. PCI operators in the UK have continued to switch to using the radial artery as the default strategy, and in 2015 radial access was used in 80.5% of all procedures (Figure 10). Analysis by country shows Northern Ireland using this route most frequently at 92%, followed by Scotland (90%), Wales 89%, and finally England at 78%.

Figure 10: Temporal trends of use of radial artery as access route

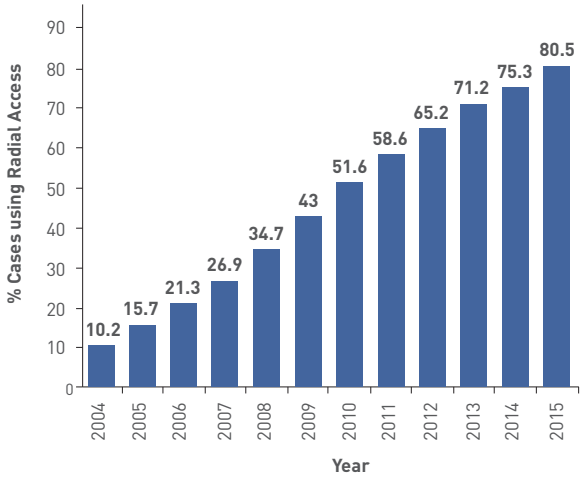
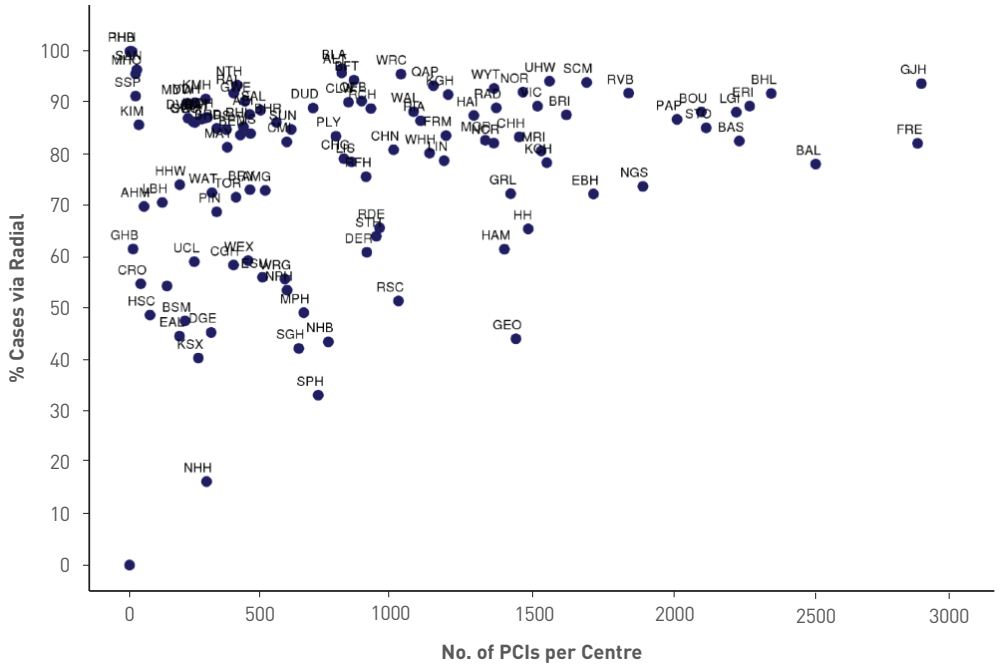


Figure 11: Percentage of patients where the radial artery access was used in individual hospitals. (See appendix 1 for hospital codes and their corresponding names.)



In spite of the increase in the use of the radial technique there remains variation in the use of this approach between different PCI centres (see Figure 11 and Table 4 in the appendix 3). The operator level data for radial access are available on the BCIS web site (patient area).

2.3.4 New stent technology

The National Institute for Health and Clinical Excellence (NICE) recommends that "Stents should be used routinely where PCI is the clinically appropriate procedure for patients with either stable or unstable angina or with acute myocardial infarction". The majority of procedures involve stent insertion (92%) which shows centres are following recommended best practice. There are some cases that do not need or cannot be treated with stents.

Drug eluting stents were developed to reduce the risk of treated arteries becoming re-narrowed. Data from multiple trials has confirmed that these devices are associated with improved outcomes, and that 'second generation' stents have better outcomes than first. The audit confirms a switch to second generation drug eluting stents. The only disadvantage of drug eluting stents is that a patient needs to be treated with anti-thrombotic drugs for longer than if they are treated with plain metal stents. Where a patient is at risk of bleeding, or needs an urgent operation, bare metal stents may be favoured.

While there has been a gradual increase in use of drug eluting stents since 2007, with 89% of cases being treated with drug eluting stents in 2015, there remains variance in their use across different centres and countries which may be explained by **case mix** and also financial pressures because drug eluting stents are more expensive (Figures 12 and 13).

Figure 12: Use of Drug Eluting Stents in PCI

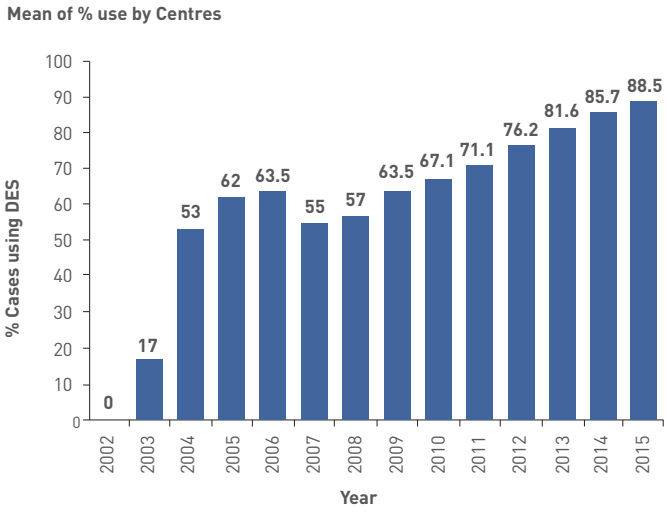
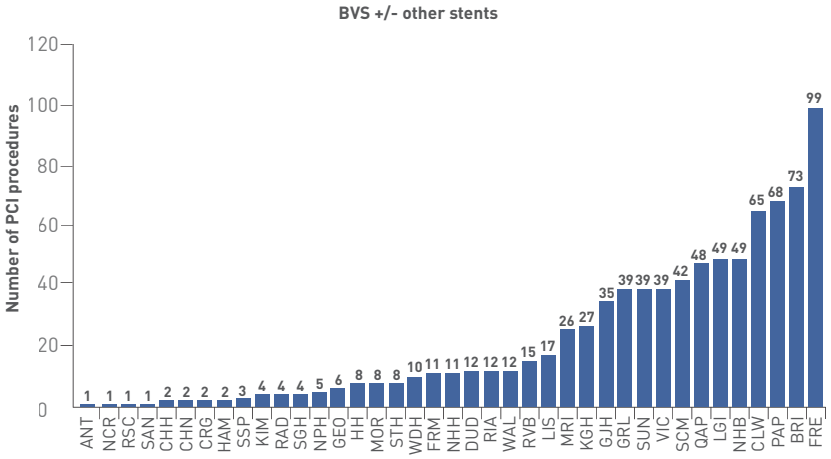


Figure 13: Use of Drug Eluting Stents in PCI hospitals in the UK. (See appendix 1 for hospital codes and their corresponding names.)

Recent trials demonstrate that newer generation drug-eluting stents are associated with slightly better outcomes for patients. There are a number of technological changes underway. Some stents are now designed where the plastic coating that contains the anti-proliferative drugs dissolve away over time. Other stents have been designed where the **anti-proliferative** drugs can be put on to the metallic stents without the need for a plastic coat.

Bio-absorbable vascular scaffolds (BVS) are another new technology. Once the artery has healed after a PCI, there should be no on-going need for a scaffold, though metal stents remain in position as permanent implants. The concept behind bio-absorbable vascular scaffolds is that they are eventually completely resorbed leaving no residual implanted material. Early data were encouraging, however, concerns have been raised about a possible increase in risk of later complication (late stent clotting) and so the precise role for these devices has yet to be defined (Figure 14). We will be following the longer term outcomes from these procedures in this audit.

Figure 14: Hospitals and their use of bio-absorbable vascular scaffolds in PCI. (See appendix 1 for hospital codes and their corresponding names.)



2.4 Patient outcomes

The complications from PCI have progressively fallen as techniques have evolved. Nevertheless, this has also meant the procedure can be offered to patients who are considerably sicker, and in whom a higher risk of complications is expected.

Emergency coronary artery surgery may be needed to treat a complication. In 2014, the rate of requirement for emergency surgery remains very low at about 0.06%. The incidence of stroke also remain low at less than 1% of all PCI procedures.

The overall rate of death in hospital following PCI has gradually increased over the years as sicker patients have been treated (particularly those with STEMI). The mortality of patients treated for similar clinical syndromes however has remained level. In the last 4 years case mix has changed little because primary PCI had been almost fully implemented across the UK. As a result the overall in hospital mortality has stabilised. The biggest predictor of mortality is how sick a patient is when they are treated, and almost invariably, a fatal outcome is a result of the patient's underlying disease, rather than due to the PCI procedure – so it occurs in spite of PCI rather than due to it.

In 2015, in-hospital mortality following PCI for stable symptoms was 0.19% following PCI for UA/NSTEMI was 0.7%, and following primary PCI for STEMI 5.3%. In the very sickest patients, who present with extremely damaged heart muscle, and are described as being in cardiogenic shock, mortality was about 33%. Nevertheless adverse outcomes will also depend on the quality of care given and the timeliness of treatment. Risk adjusted analysis attempts to account for the differences in how sick patients are when they present at the hospital, so that what remains of the variation in outcomes might be explained by the care received.

As part of the Government's Transparency Agenda introduced in 2012 some specialties have been required to report patient clinical outcomes by an individual operator, and PCI operators have been part of this initiative which is known as the Consultant Outcome Publication (COP). Outcomes are analysed using risk adjustment techniques to account for differences in case mix.

3 Use of audit data

3.1 National reporting

The audit and its dataset were designed in a way that allows reporting at the national level and inter-hospital comparisons. In the table there are examples of various activities and purposes for which audit data had been used to date:

Informing clinical guidelines	The Joint Working Group on Percutaneous Coronary Intervention of the British Cardiovascular Intervention Society and the British Cardiovascular Society used audit data to develop guidelines regarding the best practice of coronary intervention.
British Cardiovascular Intervention Society	PCI centre and Individual PCI Consultant operator outcome reports[18]. Comprehensive analysis of annual audit data from 1992 to present[19].
Transparency of data	Data underpinning some of the summary reports are published on **data.gov.uk** website.
Quality accounts	Department of Health Quality Accounts 2014/15: In their Quality Account providers must report which of the national clinical audits they participated in. This information is published annually and made available to the public, in order to ensure the accountability of NHS institutions to the public and to engage the leaders of hospitals in the quality improvement agenda of their organisation.
Indicators for quality improvement	The NHS Information Centre Indicators for Quality Improvement are a library of clinician assured national quality indicators designed to help local clinical teams select indicators for local quality improvement.
NHS England Service Level Markers	Clinical Service Quality Markers is a programme of work that aims to provide better, more accessible information for patients – an 'at a glance' indication of how well services are performing and meeting patients' needs. The intention is to develop composite measures that are based on multiple data items, whilst relying on existing data collections and indicators. The first phase of the project includes the following clinical areas; cancer, cardiac (myocardial infarction), mental health (psychosis and dementia) and musculoskeletal.
NICE Clinical Guidelines	The audit data support the NICE clinical guideline consultation process when required.

3.2 Local reporting and activity

3.2.1 Aggregate data available to participating hospitals

Hospitals that participate in the audit are sent reports with aggregate figures relating to the relevant quality standards on a regular basis. The reports specified in the table below allow hospitals to review their clinical practice on a regular basis and to validate data completeness and data quality of the submitted data. Many have reported to have used the information from these reports in their local service review or delay breaches meetings where the clinical practice is reviewed against the quality standards.

Hospital performance	'Aggregate reports' are generated by the data submitted to NICOR and distributed monthly to all PCI centres.
	'Delays reports' calculate a number of time intervals between various stages of the emergency PCI pathway and generates graphs for door to balloon times.
	Risk adjusted reports of MACCE and 30-day survival post procedure provide information on the number of actual events compared with predicted events.
Clinical performance	The NICOR database has the facility to generate reports that can be used for consultant appraisal and revalidation. All UK Consultant PCI operators are therefore able to monitor their own activity and outcomes systematically.

18. http://www.bcis.org.uk/pages/page_box_contents.asp?pageid=774&navcatid=157
19. http://www.bcis.org.uk/documents/BCIS_Audit_2014_07102015_for_web.pdf

4 The future

High quality information is vital to improve the care, treatment and outcomes for patients undergoing PCI. Our future plans continue to focus on improving the quality of data and timeliness of submission of data to NICOR.

In 2016 we plan to...

Improve the variety of reports available to individual PCI Consultant Operators to allow them to monitor their practice and outcomes

Improve data quality by encouraging the use of consistent definitions and support internal audit to assess accuracy. The responsibility for recording adverse events rests with the PCI operators, the data collection staff and clinical governance teams at the PCI hospital. These data cannot be validated by NICOR but we can support the process

Promote transparency: We will continue to publish process and outcome data for all PCI Consultant Operators in the UK on the BCIS website. In 2014, all PCI consultant risk adjusted MACCE rates were within the expected range which is extremely reassuring and shows that in the UK a safe and high quality service is being delivered. We will continue to identify areas where there is scope for improvements in both processes and outcomes.

Continue to encourage compliance with the minimum data standard set out by NICOR in collaboration with BCIS. More detail on the data standard can be found on the NICOR website: **http://www.ucl.ac.uk/nicor**

Appendix 1 List of participating hospitals & codes

NICOR code	Hospital name
RIA	Aberdeen Royal Infirmary
BRY	Acute Pennine Trust Fairfield
ALT	Altnagelvin Hospital
BAL	Barts and the London
BAS	Basildon Hospital
NHH	Basingstoke and North Hampshire Hospital
BED	Bedford Hospital
BFT	Belfast City Hospital
DUD	Birmingham City Hospital
EBH	Birmingham Heartlands Hospital
VIC	Blackpool Victoria Hospital
AHM	BMI The Alexandra Hospital
BRD	Bradford Royal Infirmary
BRI	Bristol Royal Infirmary
RHI	Calderdale Royal Hospital
CHH	Castle Hill Hospital
CHG	Cheltenham General Hospital
CGH	Conquest Hospital
CRG	Craigavon Area Hospital
CRO	Cromwell Hospital
MAY	Croydon University Hospital
CMI	Cumberland Infirmary
DVH	Darent Valley Hospital
PLY	Derriford Hospital
WDH	Dorset County Hospital
EAL	Ealing Hospital
ESU	East Surrey Hospital
DGE	Eastbourne DGH
FRE	Freeman Hospital
FRY	Frenchay Hospital
FRM	Frimley Park Hospital
GRL	Glenfield Hospital
GJH	Golden Jubilee Hospital
HAI	Hairmyres Hospital
HAM	Hammersmith Hospital
HH	Harefield Hospital
HSC	Harley Street Clinic
SCM	James Cook University Hospital

NICOR code	Hospital name
RAD	John Radcliffe Hospital
KGH	Kettering General Hospital
KIM	KIMS Hospital Kent
KCH	King's College Hospital
KMH	Kings Mill Hospital
LGI	Leeds General Infirmary
LIN	Lincoln County Hospital
LIS	Lister Hospital
BHL	Liverpool Heart and Chest Hospital
LBH	London Bridge Hospital
LDH	Luton & Dunstable Hospital
MRI	Manchester Royal Infirmary
MHO	Manor Hospital, Oxford
MDW	Medway Maritime Hospital
MOR	Morriston Hospital
MPH	Musgrove Park Hospital
NCR	New Cross Hospital
NIN	Ninewells Hospital
NOR	Norfolk and Norwich University Hospital
CLW	North Wales Cardiac Centre
NTH	Northampton General Hospital
NGS	Northern General Hospital
NPH	Northwick Park Hospital
CHN	Nottingham City Hospital
PAP	Papworth Hospital
PIN	Pinderfields General Hospital
PHB	Priory Hospital
QAP	Queen Alexandra Hospital
GWH	Queen Elizabeth Hospital Woolwich
QEB	Queen Elizabeth Hospital, Edgbaston
RAI	Raigmore Hospital
AEI	Royal Albert Edward Infirmary
BHR	Royal Berkshire Hospital
BLA	Royal Blackburn Hospital
BOU	Royal Bournemouth General Hospital
NHB	Royal Brompton Hospital
RCH	Royal Cornwall Hospital
DER	Royal Derby Hospital

NICOR code	Hospital name
RDE	Royal Devon & Exeter Hospital
RFH	Royal Free Hospital
GWE	Royal Gwent Hospital
ERI	Royal Infirmary of Edinburgh
RSC	Royal Sussex County Hospital
BAT	Royal United Hospital Bath
RVB	Royal Victoria Hospital
SAL	Salisbury District Hospital
SAN	Sandwell General Hospital
SCU	Scunthorpe General Hospital
SGH	Southampton General Hospital
BSM	Southmead Hospital
GHB	Spire Bristol
SSP	Spire Shawfair Park Hospital
ANT	St Anthony's Hospital
GEO	St George's Hospital
SPH	St Peter's Hospital
STH	St Thomas Hospital

NICOR code	Hospital name
SUN	Sunderland Royal Hospital
PMS	The Great Western Hospital
IPS	The Ipswich Hospital
TOR	Torbay Hospital
KSX	Tunbridge Wells Hospital
UCL	University College Hospital
WAL	University Hospital Coventry
STO	University Hospital of North Staffordshire
UHW	University Hospital of Wales
WAT	Watford General Hospital
HHW	Wellington Hospital North
WEX	Wexham Park Hospital
WHH	William Harvey Hospital
WRC	Worcestershire Royal Hospital
WRG	Worthing Hospital
AMG	Wycombe Hospital
WYT	Wythenshawe Hospital
YDH	York District Hospital

Appendix 2 Data completeness

Key

This table presents data completeness rates for key variables used for various analyses to measure the process of care and patient outcomes.

Pink – less than 50%; Light Pink – more than 50% but less than 90%; White – more than 90%; 0 = missing data

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
Aberdeen Royal Infirmary	RIA	100	100	100	100	100	100	99	100	100	100	100	97.8	99.6	99.4	99.6	100	100	1597.6
Acute Pennine Trust Fairfield	BRY	100	100	99.8	98.3	100	100	100	100	99.8	100	100	100	93.4	100	100	99.8	99.6	1590.7
Altnagelvin Hospital	ALT	100	98.5	93.7	100	100	100	98.4	96	80.9	86.8	100	39.7	55.5	77.2	82.8	98.1	98.1	1466
Barts and the London	BAL	100	100	97.8	99.7	100	99.2	98.1	99	98.9	99.6	96.6	96.5	0	41.3	0	99.7	99.7	1329.6
Basildon Hospital	BAS	100	100	90.9	99.4	100	100	91.5	97.4	95	98.2	99.9	99.2	96.1	91.1	99.2	100	100	1558.7
Basingstoke and North Hampshire Hosp	NHH	100	99.7	0	100	100	98.9	87.4	92.8	59.8	91.4	58.7	99.5	47.5	18.2	94.5	98.9	99.5	1247.3
Bedford Hospital	BED	100	100	93.4	100	100	100	100	100	100	100	99.8	100	100	100	100	100	100	1593.2
Belfast City Hospital	BFT	100	100	100	100	100	99.9	75.3	100	100	100	100	0	16.4	92.8	0	100	100	1384.4
Birmingham City Hospital	DUD	100	100	100	100	100	97.6	95.1	99	100	100	79	99.9	90.3	62.1	100	93.2	100	1516.3
Birmingham Heartlands Hospital	EBH	100	100	98.8	99	100	98.4	98.7	98.8	100	99.2	99.9	99.6	97.5	91.7	100	100	100	1582
Blackpool Victoria Hospital	VIC	100	99.7	99.3	99.8	99.3	99.4	99.9	100	99.1	100	99.9	99.4	99.2	98.6	90.6	99.9	99.9	1584.6
BMI Park Hospital	PHN	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
BMI The Alexandra Hospital	AHM	100	100	66.7	0	96.4	92.7	67.9	82.1	100	100	100	13.7	0	0	100	100	100	1205.8
Bradford Royal Infirmary	BRD	100	100	100	100	100	98.8	100	100	99.7	99.7	99.7	99.7	100	99.7	100	100	100	1597.6
Bristol Royal Infirmary	BRI	100	100	91.7	97	99.2	98.9	96.8	98.4	99.1	99.2	99.4	97.8	96.7	98.7	98.5	99.9	89.8	1563.3
Calderdale Royal Hospital	RHI	100	100	96.7	100	98.3	92.3	96.3	99.8	100	99.5	100	100	97.4	97	0	100	100	1477.3
Castle Hill Hospital	CHH	100	100	99.3	100	100	100	100	100	99.9	100	99.9	98.9	100	98.7	97.6	100	100	1595.4

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
Cheltenham General Hospital	CHG	100	99.6	100	100	100	98.5	99.9	99.9	98.9	98.9	100	99.9	99.6	99.2	100	100	100	1594.5
Conquest Hospital	CGH	100	100	100	100	100	100	100	100	100	100	100	99.5	99.5	92.2	99	100	100	1590.7
Craigavon Area Hospital	CRG	100	100	100	100	100	100	99.5	99.7	100	99.9	100	98.7	99.5	99.9	100	100	100	1598.5
Cromwell Hospital	CRO	100	100	85.7	90	100	98	73.2	91.1	80.4	98.2	100	1.8	42.9	60.7	100	100	100	1420.2
Croydon University Hospital	MAY	100	100	99.2	100	100	100	98.6	97.1	99.8	100	100	99.4	99.6	98.6	71.4	100	100	1564.3
Cumberland Infirmary	CMI	100	100	87.4	100	99.7	98.5	86.4	89.6	97.5	96.4	71.9	97.6	47.8	45.1		99.3	99.3	1398.9
Darent Valley Hospital	DVH	100	99.6	95.3	100	100	100	89.3	99.6	89.7	91.3	100	99.2	97.2	98	100	99.6	99.6	1559.2
Derriford Hospital	PLY	100	100	100	99.8	100	100	99.7	99.9	100	100	100	99.9	95.9	93.5	96.5	100	100	1585.3
Dorset County Hospital	WDH	100	100	99.7	100	100	97.2	91.6	94.9	91	89.5	98.6	84.6	63	97.3	96	100	100	1518.8
Ealing Hospital	EAL	100	100	100	100	100	95.1	100	98.9	98.4	99.5	100	98.4	92.4	85.4	0	98.9	100	1468.6
East Surrey Hospital	ESU	100	100	92.1	98.4	100	100	81.5	84.8	97.6	95.1	94.3	99.2	85.6	91.3	85	98.6	99.8	1504.1
Eastbourne DGH	DGE	100	100	100	100	100	100	100	99.7	100	100	100	99	99.7	85.4	84.8	100	100	1569.6
Freeman Hospital	FRE	100	100	98	99.5	100	98.3	97.6	98.4	100	100	100	99.7	96.2	95.9	96.6	100	100	1580.5
Frimley Park Hospital	FRM	100	100	100	100	100	100	100	100	100	100	100	100	99.3	91.8	100	100	100	1591.1
Glan Clwyd Hospital	CLW	100	100	95.7	97.9	99.9	99.3	99	99.3	99.8	100	99.6	95.6	98	93.2	94.3	99.4	99.4	1574.8
Glenfield Hospital	GRL	100	100	99.4	100	100	99.9	99.1	97.5	100	100	100	99.9	98.5	99.2	99.5	100	100	1593.1
Golden Jubilee Hospital	GJH	100	100	91.5	100	100	100	96	96.1	99.1	99.4	99.2	100	66.5	92	57.5	100	100	1497.3
Hairmyres Hospital	HAI	100	100	99.5	20.3	98.1	81	76.2	80.1	13.3	21.7	99.6	0	0.1	24.7	34.1	99.9	100	1048.6
Hammersmith Hospital	HAM	100	100	100	99.4	100	100	100	100	100	100	100	98.3	99.6	99.8	100	100	100	1598.8
Harefield Hospital	HH	100	100	95.5	98.3	99.9	96.9	92.4	92.3	98.9	99.6	99.4	94.2	62.7	33	92.3	100	100	1461.2
Harley Street Clinic	HSC	100	100	99	100	100	100	100	100	100	100	100	1	83.3	99	50	100	100	1531.3
James Cook University Hospital	SCM	100	100	99	100	100	100	99.3	99.7	100	100	99.9	99.9	99.4	99.9	100	100	100	1597.2
John Radcliffe Hospital	RAD	100	100	98.3	100	100	99.4	99.9	99.9	96.6	98.9	98.7	93	96.7	98.2	98.9	100	100	1585.5
Kettering General Hospital	KGH	100	100	100	100	100	100	100	100	100	100	100	99.9	94.2	97.9	100	100	100	1592.1
KIMS Hospital Kent	KIM	100	97.5	100	n/a	100	100	100	100	100	100	100	0	100	100	100	100	100	1497.5

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
King's College Hospital	KCH	100	99.8	93.6	98.5	99.9	94.1	92.6	95.8	97.5	99.7	99.9	97.4	56.7	84.8	95.2	99.9	99.8	1507.8
Kings Mill Hospital	KMH	100	99.3	100	96.5	100	100	99	95	97	98	100	97	85	99	100	99.7	100	1568.5
Leeds General Infirmary	LGI	100	100	98.6	98	100	99.9	98	98.6	99.7	99.8	99.8	99.4	94.7	96.1	99.7	99.9	100	1582.8
Leeds Nuffield Hospital	LNH	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Lincoln County Hospital	LIN	100	100	78.9	100	99.8	99.5	99.7	97.8	100	100	78.4	99.9	99.4	99.8	96.8	100	100	1550.1
Lister Hospital	LIS	100	98.6	96.9	100	100	99.6	98.5	97.3	100	100	100	98.8	97.3	97.3	99	100	100	1584.5
Liverpool Heart and Chest Hospital	BHL	100	100	100	100	100	100	100	100	100	100	100	99.8	72	88.9	100	100	100	1560.9
London Bridge Hospital	LBH	100	100	99.6	100	100	100	99.6	99.6	100	100	100	1.9	84.3	99.1	100	100	100	1582.2
London Independent Hospital	IND	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Luton & Dunstable Hospital	LDH	100	100	92.2	98.4	99.6	100	94.1	99.6	74.4	97.4	100	100	99.3	89.3	66.7	100	100	1511
Manchester Royal Infirmary	MRI	100	100	100	100	100	99.9	79.9	91.7	100	99.9	99.9	98.7	100	24.4	92.1	100	100	1487.8
Manor Hospital	MHO	100	100	100	100	100	100	100	100	96	96	100	0	100	100	100	88	100	1580
Medway Maritime Hospital	MDW	100	100	98.6	81.7	99.1	98.6	86.2	98.6	77.4	91.2	99.5	96.8	30.9	16.1	11.1	91.2	98.6	1278.8
Morriston Hospital	MOR	100	99.9	98.2	97.1	100	98.9	96.6	99	99.7	99.9	98	99.2	94.8	98	94.3	99.9	100	1574.3
Musgrove Park Hospital	MPH	100	99.9	100	100	100	98.3	100	100	97.7	97.6	99.8	98.6	99.9	99.9	100	100	100	1593.1
New Cross Hospital	NCR	100	100	100	100	100	100	95.7	100	100	100	100	100	95	99.1	99.8	100	100	1589.6
Ninewells Hospital	NIN	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Norfolk and Norwich University Hospital	NOR	100	100	99.5	99.5	99.6	100	94.5	99.8	100	100	99.9	99.4	68.5	85.6	99.8	100	100	1546.7
Northampton General Hospital	NTH	100	99.7	100	100	100	100	100	99.2	99	100	100	100	98.2	100	90.9	99.7	99.7	1586.4
Northern General Hospital	NGS	100	100	85.4	84.8	100	99.8	91.1	93	99.8	99.8	100	99.2	0	0	95.6	100	100	1349.3
Northwick Park Hospital	NPH	100	99.9	99.9	100	100	100	100	100	100	100	99.8	98.8	99.9	98.4	100	100	100	1597.9
Nottingham City Hospital	CHN	100	99.8	73.3	100	100	100	74	84.1	99.5	99.5	99.3	98.6	93.3	60.1	94.8	99.9	99.9	1477.5
Nuffield Health Bournemouth Hospital	NBO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Papworth Hospital	PAP	100	100	90.9	100	100	100	94.5	91.6	100	100	100	100	90	92	100	100	100	1559

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
Pinderfields General Hospital	PIN	100	100	99.5	100	99.7	100	97.1	99.7	100	100	100	100	100	97.6	100	100	100	1593.6
Priory Hospital	PHB	100	100	100	n/a	100	100	100	100	100	100	100	0	100	100	100	100	100	1500
Queen Alexandra Hospital	QAP	100	99.9	100	100	100	99.7	98.9	99.5	99.8	99.8	99.9	98.5	97.6	91.4	99.8	100	100	1586.3
Queen Elizabeth Hospital, Edgbaston	QEB	100	100	100	100	100	100	100	99.8	100	100	100	99.7	100	100	100	100	100	1599.8
Queen Elizabeth Hospital, Woolwich	GWH	100	99.4	91.7	100	100	100	85.4	100	99.4	99.4	99.6	99.7	96.5	99.4	100	100	100	1570.8
Raigmore Hospital	RAI	100	100	96.9	100	100	100	97.2	99.2	98.2	98.5	100	97.4	100	100	100	100	100	1590
Ross Hall Hospital	RHH	100	100	100	n/a	100	85.7	100	100	100	100	100	42.9	0	0	100	100	100	1285.7
Royal Albert Edward Infirmary	AEI	100	100	99.4	100	100	99.1	100	100	93.3	95.4	100	99.8	95.6	99.2	0	99.8	100	1481.8
Royal Berkshire Hospital	BHR	100	100	100	100	100	100	100	99.8	95.2	97.1	100	98.3	92.7	94.9	99.3	100	100	1579
Royal Blackburn Hospital	BLA	100	99.9	99.9	100	95.4	100	98.6	97.4	91.1	92.1	100	98	92.8	86.5	52.4	99.2	99.2	1504.5
Royal Bournemouth General Hospital	BOU	100	100	44.7	100	100	100	87.9	95.4	66.5	88.1	99.9	99.8	76.8	89.5	87.7	100	100	1436.5
Royal Brompton Hospital	NHB	100	100	100	100	100	100	100	100	100	100	98.6	94.5	99.2	97.1	84.2	100	100	1579.1
Royal Cornwall Hospital	RCH	100	100	99.9	100	100	100	96.2	98.5	100	100	99.8	99.7	99.7	92.6	99.6	100	100	1586.3
Royal Derby Hospital	DER	100	100	94.7	99.5	100	99.4	98.3	98.6	99.7	97.4	100	98.4	42	98.1	97.6	100	100	1525.3
Royal Devon & Exeter Hospital	RDE	100	100	100	100	100	100	99.9	100	100	99.9	100	99.9	99.1	98.7	100	100	100	1597.6
Royal Free Hospital	RFH	100	100	85.7	99.8	100	99.1	100	100	100	100	99.9	98.3	23.5	0.1	89	99.9	99.9	1396.9
Royal Gwent Hospital	GWE	100	100	99.6	100	100	98.8	99.6	100	99.6	98.9	99.1	99.1	42.4	99.6	82.4	99.4	100	1519.4
Royal infirmary of Edinburgh	ERI	100	100	77.9	100	100	100	81.8	92.7	92.2	92.1	99.9	98.4	6.4	3.4	85.8	100	100	1332.2
Royal Sussex County Hospital	RSC	100	100	93.7	99.5	100	99.6	90.3	97.7	99.9	100	93.1	100	20.6	54.3	94.9	100	100	1443.6
Royal United Hospital Bath	BAT	100	100	95.4	100	99.8	100	95.6	97	93.7	94.8	99.5	99.7	51.5	67.8	72.6	99.3	99.3	1466.3
Royal Victoria Hospital	RVB	100	100	83	100	100	99.9	85.8	95.5	100	100	100	0	27	97.5	93	100	100	1481.7
Salisbury District Hospital	SAL	100	99.8	100	100	100	99	97.6	100	100	100	100	96.3	93.4	99.8	100	100	100	1589.6
Sandwell General Hospital	SAN	100	100	100	100	100	93.2	95.7	97	100	100	96	100	90.2	90.8	100	96.7	100	1559.6

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
Scunthorpe General Hospital	SCU	100	100	37	94.6	100	100	91.3	78.3	6.7	7.3	100	99.3	90.3	95.7	100	56.7	100	1257.9
Southampton General Hospital	SGH	100	99.7	100	100	100	98.1	99.9	99.7	99.6	99.3	100	96.9	99.7	100	100	100	100	1596
Southmead Hospital	BSM	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	1600
Spire Bristol	GHB	100	97.1	68.6	n/a	100	97.1	91.4	91.4	100	97.1	97.1	22.9	97.1	97.1	100	88.6	100	1422.6
Spire Cardiff Hospital	SPC	100	100	66.7	n/a	100	66.7	100	66.7	100	100	100	0	33.3	33.3	100	66.7	100	1233.4
Spire Hospital Leeds	LEB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Spire Hull & East Riding Hospital	HBP	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	n/a	100
Spire Shawfair Park Hospital	SSP	100	100	83.3	n/a	100	100	91.7	100	95.8	95.8	95.7	0	8.3	95.8	100	100	100	1366.4
Spire St Anthony's Hospital	ANT	100	100	96.8	50	100	92.8	99.4	99.4	100	98.7	100	8.3	94.9	98.1	100	100	100	1530.1
St George's Hospital	GEO	100	100	97.3	96.3	99.5	97.4	97.2	98.5	95	93.4	99.9	98.3	92.5	85.4	92.5	99.9	100	1544.8
St Peter's Hospital	SPH	100	99.9	100	100	100	100	100	100	100	100	100	99.4	98.4	63.9	100	100	100	1562.2
St Thomas Hospital	STH	100	100	96.8	100	100	100	96.2	97.1	99.9	99.9	100	98.4	93.8	99.9	94.3	100	100	1577.9
Sunderland Royal Hospital	SUN	100	100	100	100	100	98.8	100	99.5	98.8	95.4	67.3	99.5	96.3	97.4	59.4	99.8	100	1512.7
The BMI Meriden Hospital	BMI	100	100	100	n/a	100	100	100	100	90.9	81.8	90	0	100	90.9	100	100	100	1453.6
The Great Western Hospital	PMS	100	100	99	100	100	100	99	99.6	95.2	95.2	100	99.2	99.2	99.6	88.7	99.4	99.4	1574.3
The Ipswich Hospital	IPS	100	100	93.7	100	100	100	100	99.2	69.8	85.5	100	100	91.4	99.2	100	100	100	1538.8
Torbay Hospital	TOR	100	100	100	98	99.7	99	100	100	100	100	100	99.8	99.3	100	97.2	100	100	1593.2
Tunbridge Wells Hospital	KSX	100	100	98.6	100	100	100	99.6	83.3	97.8	98.2	100	99.6	98.6	89.9	100	98.9	98.9	1563.8
University College Hospital	UCL	100	99.6	86.9	100	100	100	91	93.6	77.2	84.3	99.6	87.5	82	80.1	90.9	99.6	100	1484.8
University Hospital Coventry	WAL	100	99.7	99.3	99.6	100	99.8	97.9	98.3	91.5	100	100	99.3	2.7	47.3	77.5	100	100	1413.6
University Hospital of North Staffordshire	STO	100	99	100	100	99.7	97.2	83.3	98.6	97.7	98.8	100	98.1	58.4	82.5	98.6	95.7	99.9	1509.4
University Hospital of Wales	UHW	100	99.9	91.9	96.8	99.4	99.5	95.3	96.6	81.2	96.7	95.3	73.2	44.6	98.4	74.2	93.2	100	1463
Watford General Hospital	WAT	100	99.4	100	98.1	100	100	99.4	99	93.5	93.8	99.7	96.1	85.1	75.6	61.9	97.7	97.7	1500.9

Hospital name	Hospital code	Date of birth	Sex	Medical history	Pre procedure shock	Procedure urgency	Vessels treated	Renal disease	Diabetes	Discharge date	Discharge status	PCI hospital outcome	NHS number	Creatinine	Weight	Patient location at time of STEMI onset (for patients treated for acute STEMI only)	Consultant responsible GMC Number	Consultant responsible Name	score (excl NHS No)
Wellington Hospital North	HHW	100	100	91.9	100	100	100	97.6	88.9	100	100	99.3	3.6	85.1	99.2	50	99.7	100	1511.7
Wexham Park Hospital	WEX	100	99.2	95.8	97.1	100	100	97.7	97.9	97.9	100	97.9	97.7	78.7	98.5	71.1	31.4	98.9	1462.1
William Harvey Hospital	WHH	100	100	89.7	96.3	99.6	99.1	91.4	92	96.5	96.8	96.6	97.1	96.6	97.5	96.9	99.7	99.9	1548.6
Worcestershire Royal Hospital	WRC	100	100	98.3	100	100	100	100	100	100	100	100	99.9	99.1	99.9	97.1	100	100	1594.4
Worthing Hospital	WRG	100	100	99.7	100	100	100	93.3	99.6	99	99.9	100	99.7	95	75	100	98.2	98.4	1558.1
Wycombe Hospital	AMG	100	99.6	100	98.5	100	99.8	94.7	92.9	98.2	99.6	100	99.6	100	98.9	82.1	99.8	100	1564.1
Wythenshawe Hospital	WYT	100	100	98.2	99.9	100	99.9	86.6	96.2	100	100	100	99.7	99.5	94.7	100	100	100	1575
York District Hospital	YDH	100	100	100	99.4	97.1	99.6	96.6	96.9	88.9	88.9	100	100	98.9	13.8	66.7	99.6	100	1446.4

Appendix 3 Arterial access

	2014			2015	
Hospital name	**Hospital code**	**Number of records eligible for this analysis**	**Percentage of procedures where right or left radial artery was used for access**	**Number of records eligible for this analysis**	**Percentage of procedures where right or left radial artery was used for access**
		n	**%**	**n**	**%**
		93143	**75.30**	**93143**	**77.95**
Aberdeen Royal Infirmary	RIA	1044	83.52	1067	86.5
Acute Pennine Trust Fairfield	BRY	438	56.85	442	73.08
Altnagelvin Hospital	ALT	581	94.49	778	95.83
Spire St Anthony's Hospital	ANT	n/a	n/a	138	54.35
Barts and the London	BAL	2126	67.50	2514	78.08
Basildon Hospital	BAS	2050	77.56	2234	82.56
Basingstoke and North Hampshire Hospital	NHH	461	1.95	283	16.27
Bedford Hospital	BED	434	81.80	407	83.74
Belfast City Hospital	BFT	1075	94.23	823	94.41
Birmingham City Hospital	DUD	528	83.90	673	88.99
Birmingham Heartlands Hospital	EBH	1598	71.53	1700	72.25
Blackpool Victoria Hospital	VIC	1541	82.93	1495	89.34
BMI The Alexandra Hospital	AHM	24	70.83	54	69.81
BMI. The BMI Meriden Hospital	NA	n/a	n/a	10	100
Bradford Royal Infirmary	BRD	294	83.67	320	85
Bristol Royal Infirmary	BRI	1413	78.63	1601	87.65
Calderdale Royal Hospital	RHI	460	88.48	418	85.34
Castle Hill Hospital	CHH	1354	79.39	1428	83.35
Cheltenham General Hospital	CHG	775	76.39	786	79.11
Conquest Hospital	CGH	425	57.41	382	58.42

	2014			2015	
Hospital name	Hospital code	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access
Craigavon Area Hospital	CRG	713	92.99	0	NA
Cromwell Hospital	CRO	52	42.31	43	54.76
Croydon University Hospital	MAY	347	66.57	359	81.34
Cumberland Infirmary	CMI	607	85.01	577	82.4
Darent Valley Hospital	DVH	247	87.45	215	86.98
Derriford Hospital	PLY	755	84.11	757	83.49
Dorset County Hospital	WDH	397	85.14	287	87.19
Ealing Hospital	EAL	206	22.33	184	44.57
East Surrey Hospital	ESU	424	15.57	488	56.04
Eastbourne DGH	DGE	347	44.38	300	45.3
Freeman Hospital	FRE	2900	79.83	2887	82.1
Frenchay Hospital	FRY	97	36.08	0	NA
Frimley Park Hospital	FRM	1128	78.99	1160	83.62
Glasgow Royal Infirmary	GRI	n/a	n/a	0	NA
Glenfield Hospital	GRL	1320	71.89	1397	72.3
Golden Jubilee Hospital	GJH	2795	93.92	2901	93.73
Hairmyres Hospital	HAI	1369	86.41	1262	87.53
Hammersmith Hospital	HAM	1360	49.34	1374	61.5
Harefield Hospital	HH	1512	60.52	1461	65.45
Harley Street Clinic	HSC	81	35.80	76	48.68
Hemel Hempstead General Hospital	HHH	n/a	n/a	0	NA
Hull Royal Infirmary	HRI	n/a	n/a	0	NA
James Cook University Hospital	SCM	1766	92.92	1675	93.97
John Radcliffe Hospital	RAD	1515	83.50	1344	89.02
Kettering General Hospital	KGH	1216	84.54	1168	91.6
KIMS Hospital Kent	KIM	9	77.78	35	85.71
King's College Hospital	KCH	1336	76.87	1529	78.34

	2014			2015	
Hospital name	Hospital code	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access
Kings Mill Hospital	KMH	138	68.84	280	90.76
Leeds General Infirmary	LGI	2288	85.01	2223	88.16
Lincoln County Hospital	LIN	1076	77.42	1153	78.75
Lister Hospital	LIS	734	72.75	814	78.5
Liverpool Heart and Chest Hospital	BHL	2652	87.48	2351	91.81
London Bridge Hospital	LBH	126	60.32	121	70.59
Luton & Dunstable Hospital	LDH	132	83.33	266	86.84
Manchester Royal Infirmary	MRI	1689	68.09	1509	80.64
Manor Hospital, Oxford	MHO	22	90.91	23	95.65
Medway Maritime Hospital	MDW	168	83.33	213	89.9
Morriston Hospital	MOR	1133	82.44	1304	82.7
Musgrove Park Hospital	MPH	664	35.09	639	49.14
New Cross Hospital	NCR	1263	80.92	1335	82.15
Ninewells Hospital	NIN	754	86.87	0	NA
Norfolk and Norwich University Hospital	NOR	1401	87.87	1442	92.09
North Wales Cardiac Centre	CLW	533	92.68	803	90.11
Northampton General Hospital	NTH	383	81.46	396	93.43
Northern General Hospital	NGS	1737	70.70	1881	73.73
Northwick Park Hospital	NPH	588	41.33	578	53.52
Nottingham City Hospital	CHN	1054	75.81	968	80.85
Papworth Hospital	PAP	2214	82.16	2006	86.77
Pinderfields General Hospital	PIN	314	57.64	320	68.77
Priory Hospital	PHB	23	82.61	2	100
Queen Alexandra Hospital	QAP	1096	89.96	1114	93.33
Queen Elizabeth Hospital Woolwich	GWH	212	60.85	241	86.19

	2014			2015	
Hospital name	Hospital code	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access
Queen Elizabeth Hospital, Edgbaston	QEB	694	89.77	851	90.35
Raigmore Hospital	RAI	364	84.89	383	91.86
Ross Hall Hospital	RHH	n/a	n/a	4	100
Royal Albert Edward Infirmary	AEI	342	91.52	441	87.76
Royal Berkshire Hospital	BHR	390	82.31	539	86.17
Royal Blackburn Hospital	BLA	725	96	778	96.64
Royal Bournemouth General Hospital	BOU	2044	80.53	2095	88.21
Royal Brompton Hospital	NHB	753	39.44	729	43.47
Royal Cornwall Hospital	RCH	810	86.42	885	88.89
Royal Derby Hospital	DER	1048	48.95	870	60.9
Royal Devon & Exeter Hospital	RDE	898	50.22	917	65.65
Royal Free Hospital	RFH	745	68.59	867	75.62
Royal Gwent Hospital	GWE	446	92.83	424	90.31
Royal Infirmary of Edinburgh	ERI	1653	87.11	2272	89.35
Royal Sussex County Hospital	RSC	1023	47.51	986	51.43
Royal United Hospital Bath	BAT	519	81.50	278	87
Royal Victoria Hospital	RVB	1682	92.03	1829	91.88
Salisbury District Hospital	SAL	433	89.84	481	88.57
Sandwell General Hospital	SAN	461	87.42	28	96.43
Scunthorpe General Hospital	SCU	282	42.20	235	86.27
Southampton General Hospital	SGH	637	46.78	621	42.19
Southend Hospital	SEH	n/a	n/a	0	NA
Southmead Hospital	BSM	91	45.05	204	47.55
Spire Cardiff Hospital	SPC	n/a	n/a	3	100
Spire Bristol	GHB	27	44.44	14	61.54

	2014			2015	
Hospital name	Hospital code	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access
Spire Shawfair Park Hospital	SSP	29	79.31	23	91.3
Spire Southampton Hospital	CBS	n/a	n/a	0	NA
St Anthony's Hospital	ANT	145	37.93	0	NA
St George's Hospital	GEO	1528	32.98	1416	44.07
St Marys Hospital, Paddington	STM	n/a	n/a	0	NA
St Peter's Hospital	SPH	704	32.67	692	33.09
St Thomas Hospital	STH	946	40.27	905	64.03
Sunderland Royal Hospital	SUN	529	80.91	593	84.82
The Great Western Hospital	PMS	306	81.05	444	84.02
The Ipswich Hospital	IPS	242	73.55	356	84.79
Torbay Hospital	TOR	414	65.22	391	71.61
Tunbridge Wells Hospital	KSX	229	11.35	253	40.32
University College Hospital	UCL	714	52.24	238	59.07
University Hospital Coventry	WAL	1023	85.73	1041	88.27
University Hospital of North Staffordshire	STO	1965	84.58	2113	85.11
University Hospital of Wales	UHW	1532	91.91	1539	94.2
Watford General Hospital	WAT	240	66.25	303	72.49
Wellington Hospital North	HHW	270	68.15	185	74.05
Western General Hospital	WGE	n/a	n/a	0	NA
Western Infirmary	WIG	n/a	n/a	0	NA
Wexham Park Hospital	WEX	355	50.99	435	59.29
Whipps Cross Hospital	WHC	n/a	n/a	0	NA
William Harvey Hospital	WHH	977	67.35	1100	80.2
Worcestershire Royal Hospital	WRC	996	94.58	995	95.58
Worthing Hospital	WRG	536	37.31	570	55.71

	2014			2015	
Hospital name	Hospital code	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access	Number of records eligible for this analysis	Percentage of procedures where right or left radial artery was used for access
Wycombe Hospital	AMG	482	67.84	498	72.93
Wythenshawe Hospital	WYT	1191	90.43	1336	92.8
York District Hospital	YDH	209	89	241	90.04

Glossary

A	
Acute coronary events	This term covers all cardiac episodes that result from sudden and spontaneous blockage or near blockage of a coronary artery, often resulting in some degree of cardiac damage. The underlying cause of the clot is rupture of the fine lining of a heart artery (plaque rupture), which allows blood to come in contact with the tissues of the wall of the artery, promoting the development of clot. The degree of damage and the type of syndrome (heart attack) that results from the blockage depends on the size and position of the artery and the amount of clot that develops within the artery. Not all acute coronary syndromes are suitable for treatment with primary angioplasty or thrombolytic drugs, and the decision is mainly guided by the appearances of the ECG.
Angina	Symptoms of chest pain that occur when narrowing of the coronary arteries prevent enough oxygen containing blood reaching the heart muscle when its demands are high, such as during exercise.
Angiography	An X-ray investigation performed under a local anaesthetic that produces images of the flow of blood within an artery (in this case the coronary artery). Narrowing and complete blockages within the arteries can be identified during the angiography and this allows decisions to be made regarding treatment. Often an angiogram is an immediate precursor to PCI and stent implantation or to coronary artery bypass grafting.
Atherosclerosis	A process where the walls of the arteries develop fatty deposits called atheroma.
C	
Cardioversion	Process by which the heart is restored to normal rhythm by using an externally applied electric shock.
Case mix	Different types of patients treated by a hospital or an operator.
Coronary heart disease (CHD)	A group of diseases that includes stable and unstable angina, myocardial infarction and sudden coronary death. It is a results of the narrowing or blockage of the coronary arteries, usually caused by atherosclerosis.
Coronary lesions	Is a tearing on the internal walls of the artery that can be stable and unstable.
D	
Door-to-balloon (DTB) time	The interval between the ambulance arriving at a PCI hospital and the performance of primary PCI.
E	
Elective patients	Elective surgery or elective procedure is surgery that is scheduled in advance because it does not involve a medical emergency. A stable condition is one in which the condition of the patient is not expected to change in the near future.
Electrocardiogram (ECG)	A test to record the rhythm and electrical activity of the heart. The ECG can often show if a person has had a heart attack, either recently or some time ago. It can also tell if reperfusion therapy is appropriate and if it has been effective.
F	
Funnel plots	In essence, each individual value is compared to the overall mean, and the control limits around that mean diminish as the number of subjects (or admissions) increases (as one would expect). A value which falls outside the 'funnel' is considered an outlier, and can represent abnormally high performance as well as abnormally low performance. The width of the control limits is determined by the statistical significance level from which they are calculated. To diminish the risk of a false positive 'outlier' we use +/- 3 standard deviations, which means that the chance of an outlier happening 'accidentally' (i.e. by random chance) is no more than 0.4%. The funnel plot was adapted for comparing clinical performance of surgeons, and can also be used to compare measures such as call-to-balloon time.

H	
Heart attack	The term applied to the symptoms, usually but not always involving chest pain, which develop when a clot (thrombus) develops within a heart artery as a result of spontaneous damage to the inner lining of the artery (plaque rupture). The heart muscle supplied by the blocked artery suffers permanent damage if the blood supply is not restored quickly. The damage to heart muscle carries a risk of sudden death.
M	
Major Adverse Cardiac and Cerebrovascular Events (MACCE)	MACCE is a selection of events that can happen to patients and includes all-cause death, stroke, MI and repeat revascularization.
Myocardial infarction	Death of the cells of an area of the heart muscle (myocardium) as a result of oxygen deprivation, which in turn is caused by obstruction of the blood supply; commonly referred to as a heart attack.
N	
Non-ST elevation myocardial infarction (nSTEMI)	A heart attack that occurs in the absence of ST segment elevation on the ECG. In these patients urgent admission to hospital is mandated but immediate reperfusion therapy is not required.
O	
Operator	An interventional cardiologist performing PCI and other catheter based procedures.
Outlier	An observation that lies an abnormal distance from other values in a random sample from a population. In a sense, this definition leaves it up to the analyst (or a consensus process) to decide what will be considered abnormal. Before abnormal observations can be singled out, it is necessary to characterize normal observations.
P	
Primary PCI (pPCI)	A technique to re-open the blocked coronary artery responsible for the heart attack in patients with STEMI. It has to be performed as soon as possible after the STEMI is diagnosed to prevent loss of a heart muscle.
PCI hospital	It is a hospital equipped with catheter laboratories and trained staff to perform percutaneous coronary interventions.
R	
Revascularisation	Interventions that improve the blood supply to the heart, including PCI or coronary artery bypass grafting.
Risk adjustment	This risk adjustment method is a process used to account for the impact of individual risk factors such as age, severity of illness and other medical problems that can put some patients at greater risk of MACCE events than others.
S	
ST elevation myocardial infarction (STEMI)	Interventions that improve the blood supply to the heart, including PCI or coronary artery bypass grafting.
Survival post procedure	An interval to look at a rate of patients who survival.
U	
Unstable angina	A condition in which your heart doesn't get enough blood flow and oxygen. It is a type of acute coronary syndrome and may lead to a heart attack.

Appendix 4 Membership of NAPCI steering group/data monitoring group

Name	Role	Organisation
Dr Peter Ludman	Chairman, NAPCI Clinical Lead, BCIS Audit Lead; Consultant Cardiologist	University Hospitals Birmingham NHS Foundation Trust
Professor Adrian Banning	Consultant Cardiologist, BCIS President	Oxford Radcliffe Hospitals NHS Trust
Anthony Bradley	Acting Project Manager NAPCI	NICOR
Miles Curtis	Audit Nurse	Barts Health NHS Trust
Dr Adam de Belder	BCIS Clinical Standards Group Chair	Brighton and Sussex University Hospitals NHS Trust
Dr Mark de Belder	Consultant Cardiologist	South Tees Hospitals NHS Foundation Trust
Dr Tim Gilbert	Consultant Cardiologist	Norfolk and Norwich University Hospitals NHS Foundation Trust
Abderrahim Hechachena	Data analyst/Statistician	NICOR
Dr Rob Henderson	Consultant Cardiologist	Nottingham University Hospitals NHS Trust
Dr David Hildick Smith	BCIS Honorary Treasurer	Brighton and Sussex University Hospitals NHS Trust
Alexander McLaren	Senior Medical Device Specialist, MHRA representative	Medicines & Healthcare products Regulatory Agency
Sue Manuel	NAPCI Database Developer	NICOR
James Ian Neill	Patient representative	Retired
Dr Rod Stables	Consultant Cardiologist; Research Lead for Interventional Cardiology Institute of Cardiovascular Medicine and Science (Liverpool)	Liverpool Heart and Chest Hospital NHS Foundation Trust
Jamie Turnbull	Acting Project Manager NAPCI	NICOR
Dr Clive Weston	MINAP Clinical Lead	Abertawe Bro Morgannwg University Health Board
Keith Wilson	Patient representative	Liverpool Heart and Chest Hospital NHS Foundation Trust
Dr Andrew Wragg	Consultant Cardiologist	Barts Health NHS Trust