This report is written for the public to show the performance of hospitals, ambulance services and Cardiac Networks in England, Wales and Belfast against national standards for the care of patients with heart attack in 2011/12.

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This report was completed in close collaboration with the NICOR Technical Team (formerly known as Central Cardiac Audit Database). Sue Manuel has again been especially involved.

MINAP is commissioned and funded by the Healthcare Quality Improvement Partnership (HQIP). For more information, please visit www.hqip.org.uk.

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Hospital or ambulance service data
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NICOR is a partnership of clinicians, IT experts, statisticians, academics and managers which manages six cardiovascular clinical audits and several new technology registries. Its mission is to provide information to improve heart disease patients’ quality of care, outcomes and help to reduce inequity in care.

The Healthcare Quality Improvement Partnership (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 of clinical audit in England and Wales. HQIP hosts the contract to manage and develop the National Clinical Audit and Patient Outcomes Programme (NCAPOP). The programme comprises 40 clinical audits that cover care provided to people with a wide range of medical, surgical and mental health conditions.

Founded in 1826, UCL 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. We are among the world’s top universities, as reflected by performance in a range of international rankings and tables.

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Myocardial Ischaemia National Audit Project

How the NHS cares for patients with heart attack

Annual Public Report  |  April 2011 - March 2012
By the Interim National Clinical Director for Cardiovascular Disease (England)

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The management of patients with ACS has advanced greatly over the last decade, with a welcome improvement in survival, but there is more to be done. Over a quarter of patients with STEMI do not receive reperfusion therapy, and whilst for many there will be good clinical reasons for this, there are regional variations which suggest that some people are not getting as good a service as others. We need to find out more about the reasons for these variations and tackle any inequalities. We know also that outcomes are improved for patients with STEMI if they are admitted directly to a Heart Attack Centre, and yet around 20% of cases still present to non-interventional hospitals and have to be transferred, delaying coronary reperfusion. Cardiac Networks have done much to help drive improved performance and outcomes, and work will continue within the Strategic Clinical Networks recently announced by the NHS Commissioning Board.

Improving outcomes that are important to patients and the public has never been more central to NHS performance, and if outcomes are to be improved they must be measured. There can be few more valuable sources of information on those with acute coronary syndromes than this excellent MINAP Report.

Professor Huon H Gray
Interim National Clinical Director for Cardiovascular Disease, Department of Health (England) Consultant Cardiologist, Southampton University Hospital.
The Myocardial Ischaemia National Audit Project (MINAP) is a national clinical audit of the management of heart attack. It supplies participating hospitals and ambulance services with a record of their management and compares this with nationally and internationally agreed standards. MINAP provides comparative data to help clinicians and managers monitor and improve the quality and outcomes of their local services.

This is the eleventh annual MINAP Public Report. It presents analyses from all hospitals and ambulance services, in England, Wales and Belfast, that provided care for patients with suspected heart attack between April 2011 and March 2012 (2011/12). For the first time we present data on primary PCI within 120 minutes of calling for help. The report also presents some data from previous years. Its purpose is to inform the public about the quality of local care for heart attack patients.

Heart attack is common and remains a major cause of death and ill health. Importantly, prompt and appropriate treatment reduces the likelihood of death and recurrent heart attack. Good treatment, coupled with cardiac rehabilitation, promotes optimal recovery. Heart attack, or myocardial infarction, is part of the spectrum of conditions known as acute coronary syndromes (ACS). This term includes both ST-elevation myocardial infarction (STEMI), for which emergency reperfusion treatment with primary percutaneous coronary intervention (PCI) or thrombolytic drugs is beneficial, and non-ST-elevation myocardial infarction (nSTEMI), which represents the majority and for which a different approach is required.

Initial treatment of patients with STEMI
High quality care for STEMI includes early diagnosis and rapid treatment to re-open the blocked coronary artery responsible for the heart attack. Two forms of treatment are available. The great majority of patients now receive primary PCI, where the artery is re-opened mechanically using a balloon catheter inserted into the blocked artery and a stent is deployed within the artery. Thrombolytic treatment, where the clot is dissolved by a drug given by ambulance or hospital staff, is also available. Delay to providing either treatment is associated with poorer outcomes.

Patients who received primary PCI for STEMI
Primary PCI is the preferred treatment if it can be provided promptly. Most patients who are recognised as having a heart attack characterised by ST-elevation are taken by ambulance directly to the catheter laboratory of the nearest Heart Attack Centre, often bypassing smaller hospitals and the Accident and Emergency (A&E) department.

- This year, in England 95% of patients who received any reperfusion treatment received primary PCI compared to 82% in 2010/11. In Wales the increase was from 30% to 50%. In the Belfast hospitals the percentage of patients who received primary PCI remains unchanged at 99%.
- This year 92% of eligible patients in England, 81% in Wales and 89% in Belfast were treated with primary PCI within 90 minutes of arrival at the Heart Attack Centre.
- 83% of eligible patients in England, 78% in Wales and 88% in Belfast were treated with primary PCI within 150 minutes of calling for professional help.
- This year for the first time we report on patients who received primary PCI within 120 minutes from calling for help as follows: in England 62%, in Wales 59% and in Belfast 84%.
- Access to primary PCI is becoming more uniform. The percentage of patients in English Cardiac Networks that received primary PCI ranged between 41% and 99%; in two Cardiac Networks fewer than 50% of patients received primary PCI compared to 6 in 2010/11. In the two Welsh Cardiac Networks 6% and 64% of their patients received primary PCI.
- 79% of patients that were treated with primary PCI were admitted directly to a Heart Attack Centre in England, 86% in Wales and 79% in the Belfast hospitals.
Patients who received thrombolytic treatment for STEMI

As the number of patients having primary PCI has increased, the number having thrombolytic treatment, either before or on arrival at hospital, has fallen.

- 54% of eligible patients received thrombolytic treatment within 60 minutes of calling for professional help in England; 48% in Wales. Thrombolytic treatment is not used in the Belfast hospitals.
- 70% of patients who received thrombolytic treatment or had no reperfusion treatment had, or were later referred for, coronary angiography in England; 88% in Wales and 74% in Belfast.

Thrombolytic treatment given by paramedics before the patient reaches hospital

For many ambulance services, the focus has shifted from provision of early pre-hospital thrombolytic treatment to identifying those patients with a heart attack who might benefit from primary PCI, and transferring these patients rapidly to a Heart Attack Centre. This means that for many ambulance services the number of patients receiving pre-hospital thrombolytic treatment has declined.

- 210 patients received pre-hospital thrombolytic treatment in England in 2011/12 compared to 824 in 2010/11, a decrease of 75%. In Wales 154 patients received pre-hospital thrombolytic treatment compared to 219 in 2010/11. Pre-hospital thrombolytic treatment is not used in Belfast.

Patients that received no reperfusion treatment

Some patients arriving at hospital with evidence of STEMI receive neither primary PCI nor thrombolytic treatment – no reperfusion therapy is provided – often because they present to hospital too late to benefit from such treatments, or during emergency coronary angiography they are found to have coronary arteries that do not require intervention.

- In England 30% of patients with STEMI received no reperfusion compared with 31% in 2010/11. In Wales 27% of patients with STEMI received no reperfusion compared with 31% in 2010/11 and in Belfast 29% of patients with STEMI received no reperfusion compared with 30% in 2010/11.

Care of patients with nSTEMI

Patients with nSTEMI have a lower early risk of death within the first month, but appear to be at similar or even greater long-term risk than patients with STEMI. Perhaps because they do not require very rapid emergency treatment (reperfusion therapy), they are not always admitted to cardiac care units and are not always cared for by cardiologists. However, specialist involvement has been shown to lead to better outcomes. The performance of angiography and coronary intervention soon, and within the first 2-4 days (see Figure 17), is an important facet of treatment for the majority of these patients. Ideally, admission should be to a cardiac facility where nursing staff have cardiac nursing expertise and there is easy access to cardiological advice. This year:

- 51% of nSTEMI patients were admitted to a cardiac unit or ward in England, 64% in Wales and 87% in Belfast.
- 93% of nSTEMI patients were seen by a cardiologist or member of their team in England, 81% in Wales and 100% in Belfast. However the Welsh data are incomplete as 3/18 hospitals did not enter data on their nSTEMI patients.

Prescription of secondary prevention medication

Taking secondary prevention drugs after the acute event (for both STEMI and nSTEMI patients) reduces the risk of death and further heart attack. The proportion of patients in England, Wales and Belfast who are suitable for such treatment and in whom secondary prevention medication is prescribed on discharge from hospital continues at over 95% for each of the five drug classes monitored.

Falling mortality

There has been a year on year fall in the percentage of patients with STEMI and nSTEMI who die within 30 days of admission to hospital (Figure 19 and 20).
Part One: Introduction

1. Background to heart attacks

The term ‘heart attack’, while used widely in discussions between clinicians and their patients, and therefore in this public report, is too imprecise to define the condition that is the subject of this national clinical audit. The preferred term is Acute Coronary Syndrome (ACS). This covers the symptoms and clinical features that occur when there is an abrupt reduction in the blood supply to a segment of heart muscle. Usually this is a consequence of a slowly progressive build-up of fibro-fatty material (atheroma) within the wall of the coronary artery, occurring over years and often without symptoms, followed by sudden disruption of the internal artery wall. This readily causes blood to clot within the artery – a coronary thrombosis – and leads to a state of myocardial ischaemia, in which the demands of the affected heart muscle for oxygen-rich blood exceed the supply of such blood down the clot-containing artery.

If ischaemia is sufficiently prolonged or complete, death of heart muscle results. This is myocardial infarction and is confirmed if evidence of heart muscle cell death is found on blood testing. Such evidence may take some hours to appear and, to be most effective, treatment must start before the results of such tests are available. Ischaemia is suggested by characteristic symptoms (for example central chest discomfort, sweating, breathlessness) and abrupt changes in blood pressure, heart rate and heart rhythm (sometimes leading to collapse or sudden death). Ischaemia often can be detected as electrical alterations on the electrocardiogram (ECG). When symptoms start it is uncertain whether the ischaemia will be transient, and of no long-term consequence, or whether it will be prolonged and progress to infarction and consequent failure of the heart to pump strongly. Rather than waiting to find out, all patients require urgent treatment to reverse ischaemia and prevent, or limit, infarction.

Heart attack can occur at any age, but it is very rare to experience one before middle age – consistently, most patients in MINAP have been older than 65 years. This is because the deposition of atheroma (see above) in the walls of coronary arteries takes place over many years. Advanced investigations can demonstrate coronary atheroma in many people in their 30s and 40s who have no symptoms, yet who eventually suffer a sudden coronary thrombosis many years later. A variety of genetic and potentially modifiable lifestyle factors increase the likelihood that a person will develop atheroma and later heart attack. The most easily recognised of these include higher levels of blood lipids (e.g. cholesterol), blood glucose (i.e. diabetes) and blood pressure (hypertension), a family history of premature coronary disease, a sedentary lifestyle with limited physical exercise, and cigarette smoking. Many of these risk factors may be found in individual, where they appear substantially to magnify the likelihood of suffering heart attack, or other vascular disorders. Some of them can be altered with a reduction in the chances of heart attack and stroke – even in those who have already experienced such an event – forming part of the rationale for both secondary preventive drug therapy and cardiac rehabilitation programmes.

1.1 STEMI and nSTEMI

Based upon the ECG, patients with characteristic symptoms are categorised into those with, and those without, ST segment elevation – leading to the final diagnosis of those with ST-elevation myocardial infarction (STEMI) and those with non-ST-elevation myocardial infarction (nSTEMI). A typical ECG showing STEMI can be found accompanying the case study from St George’s Hospital, London, later in this report [see part three, case study 11]. ST-elevation usually indicates complete blockage of a coronary artery and warrants specific immediate treatment to re-open the artery – see ‘reperfusion therapy’ below. The absence of ST-elevation usually indicates that any coronary thrombosis is only partially occluding the artery.

Although patients with STEMI are at greater early risk, the medium to long-term outcome (in terms of recurrent heart attack or death) is similar, if not worse, for those with nSTEMI – who are generally an older group. Each year MINAP reports more patients with nSTEMI than STEMI. Within the last three years the National Institute for Health and Clinical Excellence (NICE) has published guidelines for the management of patients with nSTEMI, as well as the supporting evidence upon which the guidelines are based.

1.2 Aims of management

The aims of management of acute coronary syndrome are presented in Figure 1 together with examples of some interventions that have been shown to be associated with better outcomes for patients, and have therefore been included in various guidelines. Not all patients require all the interventions and some interventions are unsuitable – contraindicated – in some patients. Therefore, clinicians involved in providing care do not blindly follow protocols of treatment but must use their clinical judgement to determine when particular treatments should be used, and when best avoided, in individual patients.

For patients with symptoms of ACS presenting without ST-elevation there appears to be a clinically important spectrum of risk. This allows patients to be identified who would benefit most from a more interventional approach – in particular an early coronary angiogram. Risk can be predicted by...
considering such factors as the age of the patient, their blood pressure and heart rate on admission to hospital and certain aspects of their ECG and blood analyses. The NICE guideline supports the use of risk scoring in nSTEMI and the MINAP dataset contains data fields to allow this risk stratification.

Figure 1. Aims of management of Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Aims</th>
<th>Examples of interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prompt recognition of symptoms</td>
<td>Public education</td>
</tr>
<tr>
<td></td>
<td>Education of professionals</td>
</tr>
<tr>
<td>Provision of heart monitoring &amp; resuscitation</td>
<td>Ambulance ‘999’ response</td>
</tr>
<tr>
<td></td>
<td>Hospital Cardiac Care Units</td>
</tr>
<tr>
<td>Restoration of coronary blood flow</td>
<td>Reperfusion treatment</td>
</tr>
<tr>
<td></td>
<td>■ Primary percutaneous coronary intervention</td>
</tr>
<tr>
<td></td>
<td>■ Thrombolytic therapy</td>
</tr>
<tr>
<td></td>
<td>Nitrates</td>
</tr>
<tr>
<td></td>
<td>Elective angioplasty/Coronary Artery Bypass Surgery</td>
</tr>
<tr>
<td>Prevention of further coronary thrombosis</td>
<td>Anticoagulants</td>
</tr>
<tr>
<td></td>
<td>Antiplatelet agents</td>
</tr>
<tr>
<td>Reduction &amp; reversal of ischaemia</td>
<td>Reperfusion treatment</td>
</tr>
<tr>
<td></td>
<td>Anti-anginal drugs</td>
</tr>
<tr>
<td></td>
<td>e.g. beta blockers, nitrates</td>
</tr>
<tr>
<td>Stabilisation of coronary artery</td>
<td>Statins</td>
</tr>
<tr>
<td>Optimise healing</td>
<td>Angiotensin Converting Enzyme inhibitor</td>
</tr>
<tr>
<td>Prevention of future myocardial infarction</td>
<td>Secondary prevention drugs</td>
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<tr>
<td></td>
<td>Lifestyle changes</td>
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<tr>
<td>Education &amp; support, promotion of healthy lifestyles</td>
<td>Hospital cardiac nurse specialists</td>
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<tr>
<td></td>
<td>Cardiac Rehabilitation classes</td>
</tr>
<tr>
<td></td>
<td>Patient support groups</td>
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<td></td>
<td>Public Health Initiatives</td>
</tr>
</tbody>
</table>

1.3 Reperfusion therapy

These are treatments given to restore coronary blood flow by re-opening the blocked coronary artery that is causing the ACS; thereby reducing the amount of heart damage. If reperfusion is to be of benefit it needs to happen as quickly as possible, before all the heart muscle at risk has been damaged. These therapies are therefore used in the immediate management of those with STEMI (see above). If patients delay too long after the start of their symptoms reperfusion therapy may be of no value and would not then be advised.

Two forms of treatment exist: primary percutaneous coronary intervention (PCI) – where the coronary artery is opened mechanically using a balloon catheter and a stent is then left in the artery to prevent re-occlusion (see the figure accompanying the case report from St George’s Hospital, London); and thrombolytic therapy – where the clot is dissolved by a drug. Thrombolytics are given by intravenous injection and can therefore be delivered rapidly, preferably even before arriving at hospital. While the drug can be given quickly, its effect on the blood clot is not immediate and varies from person to person – in some failing to re-open the artery at all. Primary PCI requires specialised equipment and highly-trained clinical staff within the hospital. Patients tend to wait longer for primary PCI than they would for thrombolytic treatment, but the final results are more reliable in terms of complete restoration of coronary blood flow, see Figure 2.

Figure 2. Reperfusion therapy in ST elevation myocardial infarction

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombolytic drugs</td>
<td>Fails in at least 20%</td>
</tr>
<tr>
<td>Established treatment</td>
<td>Risk of bleeding and stroke</td>
</tr>
<tr>
<td>Simple administration (intravenously)</td>
<td></td>
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<tr>
<td>Potentially available in all hospitals</td>
<td></td>
</tr>
<tr>
<td>Pre-hospital use by ambulance paramedics</td>
<td></td>
</tr>
<tr>
<td>Primary angioplasty</td>
<td>Not available in all centres</td>
</tr>
<tr>
<td>Successful in at least 95%</td>
<td>Treatment must be delayed until arrival at hospital</td>
</tr>
<tr>
<td>Lower stroke risk</td>
<td>Risk of bleeding</td>
</tr>
<tr>
<td>Allows visualisation of all coronary arteries</td>
<td></td>
</tr>
<tr>
<td>Cardiologist necessarily involved in care of all patients</td>
<td></td>
</tr>
<tr>
<td>Randomised trials suggest primary angioplasty more effective than thrombolytic therapy</td>
<td></td>
</tr>
</tbody>
</table>

2. Background to MINAP

2.1 A look back

By the end of the 1980s large randomised trials, in carefully selected groups of patients, confirmed the effectiveness of clinical treatments of heart attack, and provided robust evidence upon which to base recommendations for best management. In particular, the recognition that thrombolytic drugs had substantial benefits when given early after the onset of symptoms led to the realisation that it also mattered how and when a treatment was given as well as whether it was given. Measurable targets for treatment, such as door-to-needle time and call-to-needle time appeared in national guidelines, together with advice that hospitals “should provide audit data of delays to treatment” (against agreed standards).3.

Some cardiologists established the Myocardial Infarction Audit Group and began, from 1992, to share their data, and

demonstrated significant variations in practice\textsuperscript{4}. At the same time Government officials began to recognise the potential gain to public health from the optimum management of heart attack. Setting, delivering and monitoring standards became an imperative, resulting in much professional and public engagement in describing both potential health outcome indicators\textsuperscript{5} and the standards of care expected by patients with coronary disease, expressed within a National Service Framework (NSF).\textsuperscript{6} This mandated every acute hospital to make available clinical audit data that was no more than 12 months old and suggested that “where relevant” these should be “derived from participation in national audits”.

A Myocardial Infarction (later, ischaemia) National Audit Project (MINAP) was established in 1999. It was founded on the following propositions:

- The audit should be a complete record of care rather than a snapshot – all (rather than a sample of) patients being included.
- The audit should be prospective – information being collected as soon after treatment as possible.
- Participating hospitals should agree both common definitions of clinically important variables and common standards of good quality care against which to audit their practice.
- Standards of care should be chosen that have a proven link to improved outcome – i.e. those aspects of care being audited, whilst capable of being expressed as measures of process or performance, should link directly to better patient outcomes.
- The practices of individual hospitals should be aggregated into a national figure – a hospital could audit against agreed standards and compare against the national aggregate.
- Sufficient data should be recorded to allow for case-mix adjustment and other techniques for investigating differences in outcomes between hospitals.
- The dataset should be revised periodically to account for the introduction of newer treatments.

The audit should maintain its credibility and validity by being guided and supported by relevant professional bodies and patient groups and be managed by a small project team.

A publicly accessible report should be published annually.

The standards presented in the NSF became the standards against which care was compared and a core dataset was prepared for participating hospitals\textsuperscript{7}. Data collection began in October 2000 and by mid-2002 all acute hospitals in England and Wales were participating in the audit.

Latterly, the government has championed ‘Transparency and Open Data’\textsuperscript{8}, wishing to promote ready access to health data, and the Editor of the British Medical Journal has challenged the British Cardiovascular Society, and others, to show clinical leadership in “pushing for public access to performance data of individual clinical teams”, asking ‘What are you doing?’\textsuperscript{9}

One answer is that for the past eleven years an annual MINAP report, of the performance of clinical teams within hospitals against nationally agreed standards, has been produced for the benefit of clinicians, hospital managers, the ‘healthcare community’ and, importantly, patients and the general public. MINAP is one of the first national audits to have data available on the data.gov.uk website as part of the Transparency Agenda\textsuperscript{10}.

2.2 Organisation of MINAP

MINAP is one of 6 national cardiac clinical audits that are managed by the National Institute for Cardiovascular Outcomes Research (NICOR), which is part of the Institute of Cardiovascular Science at University College London (UCL).

NICOR was established in 2006 by Prof Sir Bruce Keogh and is co-chaired by Prof Sir Roger Boyle and Prof John Deanfield. Its purpose is to provide information on quality and outcome of care provided to people with heart disease and to provide technical infrastructure, project management and statistical support for the national cardiac audits. NICOR is a collaborative partnership between various cardiovascular professional societies, the Department of Health in England and the Welsh Government.

MINAP is overseen by a Steering Group representing key stakeholders, including professional bodies, national government and patient representatives – in collaboration with the British Cardiovascular Society (Appendix 1). It is commissioned by the Healthcare Quality Improvement Partnership (HQIP) – the organisation that holds commissioning and funding responsibility for MINAP and other national clinical audits. An academic group, which reports to the Steering Group, has been established to facilitate research use of the data, see Part 4.

2.3 How the data are collected

The current dataset v9.1 contains 124 fields and includes pre-and in-hospital treatment, patient demographics and information
regarding previous medical history. The dataset is revised every two years to meet the requirements of users and to respond to developments in the management of ACS and is due for revision in late 2012. The dataset is available on the MINAP web pages: http://www.ucl.ac.uk/nicor/audits/minap/dataset.

Data are collected by nurses and clinical audit staff and entered in a dedicated data application (either on-line or web based). Alternatively hospital personnel may collect data using commercial software. The project uses a highly secure electronic system of data entry, transmission and analysis developed by the NICOR Technical Team. The audit has been running continuously since 2000 and all hospitals in England and Wales that admit patients with ACS contribute data (except Scarborough General Hospital and Kingston Hospital).

Participating hospitals are requested to enter all patients with suspected myocardial infarction. Approximately 91,000 records are uploaded annually and by August 2012 the database contained over 1 million records, making it the largest database of its kind in the world.

2.4 Security and patient confidentiality

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 IDs and passwords. All patient identifiable data are pseudonymised by the NICOR technical team before release to the project management team via a secure drop box on the NICOR server. Patient identifiable data are only available for the purpose of record linkage. 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 policy.

NICOR is registered under the Data Protection Act. Additionally, NICOR - of which MINAP is part - has support under section 251 of the National Health Service (NHS) Act 2006 [Ref: NIGB: ECC 1-06 (d)/2011].

NICOR staff recognise that confidentiality is an obligation and regularly undergo information governance training to ensure understanding of the duty of confidentiality and how it relates to patient data.

2.5 Case ascertainment

In practice MINAP records the great majority of patients having STEMI in England and Wales. However it is recognised that a small minority of hospitals do not enter all their nSTEMI patients, mainly due to lack of resources, although in the recent year there has been an improvement in this area. The true number of heart attacks is difficult to establish, as it is not possible to compare MINAP data with Hospital Episode Statistics (HES), the only possible comparator, except in aggregate. Although HES reports approximately 105,000 hospital admissions per year with myocardial infarction, it is not possible to separate this number into the clinical categories used within MINAP. MINAP records about 30,000 STEMIs, but only about 50,000 nSTEMIs annually. From internal data we consider that approximately 80,000 nSTEMIs per year would be an appropriate number. However, with the expanding analytical capacity within NICOR, there are now plans to explore other ways of establishing the case ascertainment rate in MINAP and to provide a clearer picture on the incidence of heart attacks in England and Wales.
Where all patients with acute coronary syndromes are admitted to the same ward or area patients can be readily identified. It is much harder where patients are not all cared for in one area, and are looked after in several wards. Under-reporting of nSTEMI patients varies between hospitals and reflects variation in resources allocated to data collection.

MINAP had 100% participation since 2002 until mid-2011 when Scarborough General Hospital stopped submitting data to MINAP altogether, whilst Kingston Hospital did not submit any data from January 2012. Participation in MINAP also requires participation in an annual data validation study, see below. The following hospitals were eligible but did not take part in the 2011 data validation study:

**England**
- Addenbrooke’s Hospital
- Hexham General Hospital
- Hinchingbrooke Hospital
- Kingston Hospital
- Milton Keynes General Hospital
- Scarborough General Hospital
- Scunthorpe General Hospital

**Wales**
- Morriston Hospital
- Neath Port Talbot Hospital
- Prince Philip Hospital
- Princess of Wales Hospital
- Royal Glamorgan Hospital
- West Wales General Hospital
- Ysbyty Gwynedd

### 2.6 Data quality

Assessment of data completion is presently based on patients with nSTEMI. The completeness of 20 key fields is continually monitored and is available to hospitals in an online view that is refreshed daily. Currently these fields continue to be 99% complete.

MINAP also performs an annual data validation study to assess the agreement of data held on the NICOR servers. Hospitals are required to re-enter data from case notes in 20 key fields (different fields to the data completeness fields, with some overlap) in 20 randomly selected nSTEMI records in an online data validation tool. Agreement between the original and re-entered data is assessed for each variable and each record. Reports showing the agreement of each variable compared to national aggregate data are sent to hospitals to allow them to identify areas for improvement. 95% of eligible hospitals in England, 69% in Wales and 2 hospitals in Northern Ireland participated in this year’s data validation study. The median score for 2011 was 95.5% (IQR 89.5-98) maintaining the high standards of 2010.

The MINAP data application contains error-checking routines, including range and consistency checks, designed to minimise common errors. MINAP provides detailed guidelines for data entry and provides a dedicated helpdesk to support problems regarding clinical definitions and data entry in a variety of clinical scenarios.

### 2.7 Improving our IT platform

Earlier this year NICOR began a major project to upgrade its data collection and management systems. The current Lotus Notes software has become increasingly unwieldy as the MINAP database has grown in size (greater than 1 million records) and complexity. A new platform will substantially improve NICOR’s ability to derive high-quality analyses from the MINAP database to inform local hospitals, ambulance trusts and patients regarding the provision of cardiac care.

The first step in this project involved a transfer of all data from the NHS Information Centre for Health and Social Care onto secure NICOR servers. This involved re-issuing a new user ID to every database user. The migration was not easy, and it led to some delays in accessing the MINAP database. Despite these difficulties, participating hospitals submitted their data on time, making possible the timely publication of this report. **We would like to thank everyone for their effort and patience during the migration.**

The second phase involves development of a new IT platform, which will be rolled out in stages throughout 2013, with the MINAP audit transferred in July/August.

### 2.8 Improving analysis

The processes that NICOR uses for analysing MINAP data have also undergone substantial changes this year. Until recently NICOR data were analysed using software and ad hoc analytic codes that were neither consistent nor easy to manage. In preparation for the incorporation of analytic technologies into the new NICOR system, code that was written in SPSS and Excel spreadsheets (for analyses presented in this annual report) was migrated to a standard cross-audit analytic platform based on the R statistical processing language - precise details are available from NICOR.

Migration of MINAP to the new platform for statistical analysis began in July 2012 and continues, with an intended completion date of June 2013.

The results presented in this annual report were generated using some, but not all, elements of the new platform. Because the new analytic platform is still under development, with incremental improvements expected over the next few months, the results presented in this report should be considered preliminary and subject to change. Any substantive differences that follow improvements in filtering and more sophisticated statistical modelling of the data will be highlighted in next year's annual report.
3. Improving quality, improving outcome

3.1 Use of primary PCI

Perhaps the most important, and certainly the most high profile, change in the management of heart attack during the twelve years of MINAP has been the implementation of a policy to provide primary PCI, rather than thrombolytic therapy, in cases of STEMI [see Figure 10]. The advantage of timely primary PCI over thrombolysis has been described above – though there is still an important role for thrombolysis in those rural areas where travel times to hospitals that provide primary PCI are long enough to negate the advantage of the procedure.

This rapid change largely has been driven by local clinicians and promoted by members of the British Cardiovascular Interventional Society and Cardiac Networks in response to a government challenge to ‘roll-out’ a primary PCI national service. Consecutive annual MINAP reports have recorded the changes and a final NHS report on the ‘roll-out’ project was published in 2012[1]. The policy has had major knock-on effects on the organisation of hospital-based cardiac services, requiring the continuous availability of expert teams of clinicians and ‘High Tech’ equipment. This has led to centralisation of services. Substantial numbers of district general hospitals no longer admit patients with STEMI. Rather, it is recommended that such patients are taken directly to a smaller number of Heart Attack Centres, serving large populations – for example the two Heart Attack Centres in Manchester serve 3 million people – and a network of smaller feeder hospitals. In some networks patients are ‘repatriated’ from the Heart Attack Centre to their local hospital following primary PCI, but often patients are discharged directly home after a stay in hospital of as little as 3 days.

National and international guidance[12 13] recommend that in the emergency treatment of patients with STEMI, primary PCI should be performed as soon as possible: within 90 minutes of arrival at hospital (door-to-balloon time) and within 150 minutes of a patient’s call for help (call-to-balloon time). Results are presented against these best practice standards, and against a more stringent ‘aspirational’ call-to-balloon target of 120 minutes, in Table 1 in the Results section.

The call-to-balloon time reflects the interval from a call for professional help to the time that the primary PCI procedure is performed. To reliably achieve this within 120 minutes, or even 150 minutes, requires significant coordination between ambulance and hospital services. Ideally, ambulance crews make an accurate diagnosis, through expert assessment of the patient and interpretation of their ECG, before taking the patient directly to the nearest Heart Attack Centre. At the hospital the provision of timely primary PCI is complex and involves close collaboration between ambulance, portering, nursing, medical, and radiographic teams. This is particularly important during ‘out of hours’ working. The percentage of patients with an admission diagnosis of STEMI who receive primary PCI within 90 minutes of arrival at the Heart Attack Centre has increased from 52% in 2003/4 to 92% in 2011/12 and is a reflection of this close collaboration [Figure 11]. In particular direct transfer of the patient from ambulance to the catheter lab without involvement of other hospitals, departments or wards has reduced delays. However, it remains the case that assessment at a local non-interventional hospital is associated with added delay and prolonged call-to-balloon times. In some areas a new metric has been introduced to record this added delay and promote the shortest possible safe assessment and stabilisation period in the initial receiving local hospital – the Door-In-Door-Out interval (DIDO) (see part three, case study 8).

3.2 From coronary care to cardiac care

Changing demographics of the UK population, coupled with reorganisation of acute services to deliver primary PCI across Cardiac Networks, has caused a significant change in the acute cardiology workload for all acute hospitals; more elderly people are being admitted with more complex cardiac problems. This prompted the British Cardiovascular Society (BCS) – the professional body associated with MINAP – to set up a Working Group on Acute Cardiac Care in 2010. The Group examined the changing nature of acute cardiac care in the UK and how, where and by whom it should best be delivered. The final report was published on the BCS website last autumn[14] and reviewed in an editorial in Heart[15].

Briefly, the report calls for enhanced access to specialised cardiac care, in dedicated acute cardiac care units, for all patients presenting with any acute cardiovascular condition.

14. From Coronary Care Unit to Acute Cardiac Care Unit – the evolving role of specialist cardiac care. Recommendations of the British Cardiovascular Society Working Group on Acute Cardiac Care. Accessible at http://www.bcs.com/documents/9A6_BCS_Report_on_Coronary_Care_Units.pdf
Whilst traditionally, the coronary care unit has been the domain of patients presenting with acute STEMI, with such patients now being concentrated in primary PCI (Heart Attack Centres), a unique opportunity has arisen to extend and expand specialist cardiac care to patients with other acute cardiac complaints who have also been shown to benefit from care by cardiology teams. In particular, there is an imperative to use such a system to provide uniformly high standard care to those with nSTEMI.

Crucial to the report was acquisition of reliable data to provide the evidence to support such recommendations. Data from MINAP regarding management of over 80,000 cases of nSTEMI between 2008 and 2009 was used to illustrate the potential benefits of dedicated cardiological care in these patients. nSTEMI care may be delivered by general physicians or cardiologists, depending on local protocols or arrangements. MINAP data indicates that those patients admitted under the care of a cardiologist or to a cardiology unit (encompassing both coronary care units and dedicated cardiology beds) were more likely to receive appropriate secondary preventative cardiac medications and were more likely to be referred on for coronary angiography and subsequent revascularisation. Most importantly, those patients under the care of cardiologists in a designated cardiac unit had significantly lower hospital length of stay and were less likely to die within 30 days after their heart attack. The arguments, therefore, for dedicated cardiological care for nSTEMI patients can clearly be made in terms of quality of care, financial expediency and clinical governance.

The Working Group’s report has already been influential in assisting Trusts where coronary care units had been threatened with downgrading or reassignment, and continues to influence Cardiac Networks across the country in terms of provision of equity of evidence-based acute cardiac care.

3.3 nSTEMI and access to angiography

The absence of ST-elevation on the presenting ECG of the patient with ACS (nSTEMI) is thought to indicate that any coronary thrombosis is not totally blocking the affected coronary artery. As such, immediate coronary angiography with a view to proceeding straight to PCI or immediate administration of a powerful thrombolytic drug, is not warranted. Often the event can be managed with a combination of drug treatments.

However, some patients with nSTEMI either do not ‘settle’, and continue to suffer ischaemic pain, or initially appear to stabilise but soon afterwards have a further heart attack. Rather than waiting for this to happen patients can be assessed within hours of admission to hospital using a variety of validated risk scores. For those of at least moderate risk, a policy of routine early angiography (and revascularisation where possible) appears to prevent more heart attacks and readmissions to hospital than medical treatment alone.

The 2009 NICE Guideline, that used MINAP data to model the implications of its recommendations, suggested that ACS patients at moderate risk, and those in whom it is possible to demonstrate residual ischaemia on testing after the acute event (evidence of persisting narrowing of a coronary artery), should be advised to have a coronary angiogram within 96 hours of admission. Other international guidelines have encouraged even earlier angiography, if only to reduce the overall length of stay in hospital.

The percentage of patients with a final diagnosis of nSTEMI (broadly reflecting the NICE classification of moderate severity) who have angiography during the admission has increased from just over 30% in 2003 to 76% in 2011/12 – as significant a change in management as the development of primary PCI for STEMI. However, angiography is not appropriate for all patients with nSTEMI and those at the very highest risk were not included in trials that demonstrated the benefit of routine angiography. So, there is no nationally agreed standard for the proportion of patients that should undergo angiography.

3.4 Of broken hearts and octopus pots

With increasing use of coronary angiography during the early management of heart attack it has become apparent that about 2% of patients admitted to hospital with features of acute myocardial infarction have a condition called Takotsubo Cardiomyopathy – also known as Stress Cardiomyopathy, Apical Ballooning Syndrome and Broken Heart Syndrome. This
is an acute heart failure syndrome in patients with acute chest pain and ECG changes. It seems likely that between 2000 and 3000 cases occur each year in the UK.

The typical patient is a post-menopausal woman (who make up about 90% of all cases) who, within minutes or hours of extreme physical or emotional stress (hence the use of 'Broken Heart syndrome'), develops acute cardiac chest pain, breathlessness, and features of heightened sympathetic nervous activity (racing heart, headache, sweating). The ECG during the acute episode usually shows ST-elevation and/or T wave inversion, consistent with, but in these particular cases not caused by, coronary artery obstruction. The corrected QT interval is frequently prolonged, sometimes to levels that might provoke sudden cardiac arrest (>500ms). Often evidence of heart muscle damage is revealed – serum cardiac enzymes, such as troponin, are elevated, though not to the higher levels seen with myocardial infarction due to coronary disease.

Patients with such symptoms and ECG changes are usually taken straight to the angiography laboratory as part of a primary PCI service (where the majority will be shown to have suffered coronary thrombosis and obstruction). However, in Takotsubo Cardiomyopathy the coronary arteries are either completely normal, or have non-obstructive coronary disease which cannot account for the abnormal contractile function of the heart shown using echocardiography or ventriculography. For while the coronary arteries appear normal or mildly affected, the entire left ventricular apex is hypo- or akinetic – contracting poorly or not at all – and this dysfunction frequently extends symmetrically upwards to involve the mid-ventricular muscle while the upper portions continue to contract vigorously. This gives a characteristic picture (see Figure 3) of 'virtual' apical ballooning on cardiac imaging, and instead of having an inverted conical shape the left ventricle takes on an appearance that is similar to the Japanese fisherman’s octopus pot, the tako tsubo. Atypical patterns are also recognised, with basal hypocontractility and apical preservation (inverted Takotsubo), and a mid-ventricular variant. Crucially this ventricular contractile dysfunction cannot be explained by a problem in a single coronary artery; it extends beyond a single coronary artery territory.

A number of cardiac complications have been recognised during the early phase, and these relate directly to the severity of the acute heart failure syndrome. These include atrial and ventricular arrhythmias, pericarditis, pulmonary oedema, cardiogenic shock, cardiac rupture, cardiac arrest and there is a recognised mortality of 2% during the acute phase. Apical thrombus is detected in 5-7% cases with associated thromboembolic complications. That being said, in many cases the heart recovers good function within weeks and months.

A role for MINAP
There is a lot to learn about this condition, not least the precise cause and the best treatment. Using new fields added to the MINAP dataset it should be possible to determine the frequency of the condition in the UK, the types of individuals it affects, their long-term prognoses and, through observation, associations of treatments in hospital and at discharge with long-term outcome.

Figure 3: Left ventriculogram-showing the left ventricle of the heart in a contracted (right) and relaxed (left) state in Takotsubo Cardiomyopathy
4. MINAP: a patient’s perspective

Sirkka Thomas

Cardiac nurse, health visitor, cardiac carer and patient, member of the Patient Panel for the London Cardiovascular Project 2012 and member of Patient Panel for the Healthcare Quality Improvement Partnership.

Some medical experts might disagree but I believe that stress, physical and mental, started me on my nSTEMI Patient Journey three years ago. My problems began with a late morning fire alarm and evacuation from the 17th floor of an office block in London’s Victoria. Ironically the occasion, on November 12, 2009, was a Cardiology meeting. At that time I was a carer for my husband who has heart failure and an Implantable Cardiac Defibrillator. After physically supporting my husband downstairs, with occupants of the building charging past us, he collapsed in distress halfway down. I, too, felt most unwell. We later learned it was only a fire drill!

In the evening I experienced chest pains, which I thought might have been muscular due to the strain which I had been under. The following day, I visited my GP. I was sweating and short of breath and the doctor phoned my husband to say I was having a heart attack. At 5.45pm I was in an ambulance where the crew diagnosed an irregular heart beat and took me to the A&E department at my local general hospital.

That happened on a Friday evening, which I discovered was the worst time to have a cardiac episode. I was seen by junior doctors and a gastroenterology consultant and spent the night in an Assessment Unit. I was not transferred to a Cardiac Care Unit until 6pm the next day and did not see a Cardiology Consultant until the Monday morning (16th). He booked me for an angiogram, to be done at a specialist centre to where I was transferred. Once there I received the diagnosis of nSTEMI, and had my angiogram, a week after my admission to the original hospital. After further tests, including an echocardiogram, I was discharged. I was told that my heart had to be monitored because I was having periods when my heart was beating slowly.

However, the tale of my journey is not meant to be a complaint about treatment. It is a statement of the facts that MINAP has highlighted. For example, MINAP figures show that in 2008/9 only 46% of nSTEMI patients were admitted to a Cardiac Ward/Unit. In 2010/11 this figure had only risen to 50%. In 2008/9 80% of such patients were seen by a cardiologist, with the figure improving to 91% in 2010/11. Still not the perfect 100%. These figures also raise the problem experienced in all areas of medical treatment: specialised care for all weekend admissions.

The first-half of my journey had been a strenuous one but the second-half went more positively, thanks to excellent monitoring and superb backing from consultants and GPs. I was followed-up throughout 2010. Then, early in 2011 I was experiencing dizziness and fainting. I was developing problems with the electrical circuits of my heart and my consultant cardiologist advised that I should have a pacemaker. Life has improved for me. I no longer suffer from dizziness and fainting. And I have had one exceptional tonic from my service on the Patients’ Panel of the London Cardiovascular Project which was implemented in March 2012. The non-ST-elevation acute coronary syndrome policy (nSTEACS) policy states that patients will be diagnosed and their risk will be identified early, with “high risk” patients being offered angiography within 24 hours of admission. If a patient is triaged in a hospital that cannot provide this investigation within the timeframe, the patient will be transferred to a hospital that can. MINAP will help to audit the provision of this standard of cardiac care.

So, my journey was really necessary and I hope it can help to provide success for others, both patients and professionals, on their journeys.

For more information about implementing the high risk nSTEACS pathway across London refer to part three, case study 3.
Alan Keys
MINAP Steering Group patient representative

I first became a patient representative in Sussex in 2004, initially with the local Primary Care Trust, then the Sussex Heart Network, leading on to a variety of other roles relating to cardiac care and more general health care.

As I became more involved I was taken aback by the paucity of good, reliable data available in the NHS, compared to my experience in the private sector. It was evident that decision making was being hampered by such deficiencies.

I also found myself in meetings with cardiologists and other health professionals arguing passionately about which care options were best for patients. The views may have differed but the motivation around patient outcomes was always central.

It was soon apparent that cardiac care had the benefit of quality data, which was often lacking elsewhere, although the quality of inputting was variable. Access to good data became useful to me as the move to primary PCI was debated and implemented. Here was the tool that enabled us all to assess how well the job was being done by local and national comparison.

In cardiac care we have a cohort of people who are motivated to perform to a high standard. I know that MINAP data has been the spur to improve data input quality, thus enabling valid comparisons to be made, leading to direct improvements in performance. Would we, for instance, have seen direct admittance to cath labs become accepted practice so quickly without the influence of comparative clinical data? Would there be confidence in the evidence to support the decisions made over primary PCI without MINAP?

From the patient perspective I would like to see door-to-balloon times monitored against a standard of 60 minutes, as well as 90 minutes. Last year Papworth was quoting 98% achievement of 90 minutes and an average of 37 minutes in the MINAP report. With the upward drift of call-to-door times this is the only way I see 120 minutes call-to-balloon becoming the norm as, ideally, it should. MINAP may also show in due course that the implications of longer call-to-door times require further thought to raise overall performance, although one must accept that geography is a major determinant as well.

I know others, with far deeper knowledge than I, have ideas on how to take clinical audit further for cardiac care, but we should recognise the influence of the MINAP approach and its potential elsewhere. The recent introduction of similar audit of stroke care [SINAP] was overdue but welcome. I have already seen urgent responses to poor SINAP data. Together they will help to drive the quality of cardiovascular and cerebrovascular care.

One also sees the culture of clinical audit influencing improvement in the Enhancing Quality project in the North West and South East. It operates across a number of disciplines, including some cardiovascular care. After some initial scepticism the potential and immediate benefits of the project are being recognised and I hope that will spread to other areas.

We should also be aware of the probable impact of the new commissioning structure on clinical audit. There can be little doubt that Clinical Commissioning Groups (CCGs) will require reliable data to assess acute providers, community services, etc., but the NHS Commissioning Board and the CCGs themselves will require measurement of primary care performance to assess how well 90% of patient contacts with the NHS are being managed and which models of care work best at GP level.
1. Characteristics of patients with heart attack in 2011/12

In 2011/12, 90,905 records in England and Wales were submitted to the MINAP database and 79,433 were records of patients with a final diagnosis of myocardial infarction. Of these some 41% had STEMI. [Fig 4] MINAP recognises that not all patients having nSTEMI are entered into the database and we believe that the true ratio for nSTEMI to STEMI should be at least 2:1.

Figure 4. Heart attacks recorded in MINAP in 2011/12

The average age for patients having a first heart attack in England and Wales was 68 years; for men 65 years and for women 73 years. Heart attack is more common in men, with two men having a heart attack for every woman. STEMI tends to present in younger age groups than nSTEMI. The average age for a first STEMI is 65 years, while that of nSTEMI is 70 years. Overall more than 49% of all heart attacks recorded in MINAP were in people over 70 years of age. While cases of STEMI appear to be equally distributed around the age-range 60-69 years, for nSTEMI the majority present older than this age [Figure 5].

Figure 5. Frequency distribution of STEMI and nSTEMI in 2011/12

Among those admitted with a first heart attack there appears to have been a levelling off in the prevalence of previously diagnosed hypertension for both females [approx. 54%] and males [approx. 43%] [Figure 6]. A similar levelling off has occurred in the prevalence [approx. 30%] of recognised and treated hyperlipidaemia [predominantly cholesterol management with statin treatment] [Figure 7]. This may reflect more efficient recognition and treatment in primary care of those at risk.

Figure 6. Hypertension in patients having first heart attack

The average age for patients having a first heart attack in England and Wales was 68 years; for men 65 years and for women 73 years. Heart attack is more common in men, with two men having a heart attack for every woman. STEMI tends to present in younger age groups than nSTEMI. The average age for a first STEMI is 65 years, while that of nSTEMI is 70 years. Overall more than 49% of all heart attacks recorded in MINAP were in people over 70 years of age. While cases of STEMI appear to be equally distributed around the age-range 60-69 years, for nSTEMI the majority present older than this age [Figure 5].
Figure 7. Patients admitted with a first heart attack already receiving treatment for hyperlipidaemia at admission

An increase over the years in the frequency of diabetes continues, with the prevalence being slightly greater in females (approx. 19%) than males (approx. 17%), and being substantially greater than in the general population. Further analysis shows that the increase is limited to those having type 2 diabetes (non-insulin dependent diabetes) [Figure 8]. It is not clear to what extent this represents a real increase, or whether this in part reflects improved recognition of type 2 diabetes in primary care.

Figure 8. Frequency of diabetes in patients having first heart attack

Cigarette smoking remains a major contributor to heart attacks in younger people, being a risk factor present in more than half of men and women under 55 years of age having a first heart attack. While the smoking rate in these younger males and females has been steadily decreasing ([Figure 9]), now the frequency of smoking in the under 55 year groups is almost as great in women as in men, and is actually greater in women aged 55-64 years than in men of that age.

Figure 9. Proportion of patients admitted with heart attack who currently smoke
2. Hospitals that perform primary PCI

National and international guidance\(^{17}\) recommend that in the emergency treatment of patients with STEMI, primary PCI should be performed within 90 minutes of arrival at the primary PCI centre (door-to-balloon time) and within 150 minutes of a patient’s call for help (call-to-balloon time). Results are presented against these best practice standards in Table 1. The sooner a patient receives this treatment, the better the outcome. The results in this table show that most of the hospitals are now achieving the call-to-balloon-time (CTB) within 150 minutes. European guidelines for 2012 propose a CTB within 120 minutes\(^{18}\) and this is also presented in the Table 1.

The use of primary PCI continued to increase in 2011/12 (Figure 10). This year in England, 19,226 patients were so treated compared to 16,037 in 2010/11, an increase of 20%. In Wales 528 patients were treated compared to 303 in 2010/11, an increase of 74%. In Belfast 153 patients were treated in 2011/12 compared to 173 in 2010/11, a decrease by 12%. Of patients who received reperfusion treatment in 2011/12, 95% of patients in England, 50% in Wales and 99% in Belfast received primary PCI. The overall median time from arrival at hospital to primary PCI was 42 minutes in 2011/12. In 28% of records this interval was less than 30 minutes and for 72% the interval was less than 60 minutes.

This year, 76 hospitals in England performed primary PCI, in Wales 3 hospitals and 1 hospital in Belfast performed primary PCI routinely. These hospitals may provide this service only for their own patients, or may do so for groups of other hospitals. Of 76 hospitals in England reporting that they were performing primary PCI on a routine basis, 52 provided the service throughout the 24 hour period. A small number shared a night time rota on an alternating basis.

The percentage of patients with an admission diagnosis of STEMI who receive primary PCI within 90 minutes of arrival at a Heart Attack Centre has increased from 52% in 2003/4 to 92% in 2011/12 and is a reflection of close collaboration between ambulance services, emergency departments and admitting hospitals. [Figure 11]. In particular direct transfer of the patient from ambulance to the catheter lab without involvement of other departments or wards has reduced delays. In the last year there was an increase in direct admissions from 10,921 in 2010/11 to 13,444 in 2011/12 in England. In Wales from 221 in 2010/11 to 397 in 2011/12. There was a slight increase in direct admissions in Belfast from 91 to 95 in 2011/12.

In Northern Ireland routine use of primary PCI is presently limited to the Belfast area. Outside Belfast thrombolytic treatment is understood to be the primary reperfusion treatment of choice for STEMI, though primary PCI is occasionally available in some hospitals. The Northern Ireland Cardiac Network is currently developing a national strategy for the management of STEMI. We look forward to the other hospitals in Northern Ireland joining MINAP before long.

Figure 10. Use of reperfusion treatment for patients with a final diagnosis of STEMI. Primary PCI makes up more than 95% of reperfusion treatment

\(^{17}\) http://www.improvement.nhs.uk/heart/?TabId=66

2.2 Call to balloon time

As explained above, this reflects the interval from a call for professional help to the time that the primary PCI procedure is performed. It is largely a shared responsibility of the relevant ambulance service and the admitting hospital. Usually all patients with a diagnosis of STEMI confirmed by a paramedic crew are taken directly to a Heart Attack Centre. This however is not always possible, particularly where there is diagnostic uncertainty, or in remoter parts of the country.

In England, 83% of all eligible patients were treated within 150 minutes of calling for professional help compared to 81% in 2010/11. In Wales 78% of patients were treated within 150 minutes compared to 75% in 2010/11. In Belfast 88% of patients were treated within 150 minutes compared to 91% in 2010/11.

This year for the first time we report on the proportion of patients who received primary PCI within 120 minutes of calling for help. In England, 62% of patients received primary PCI within 120 minutes of calling for professional help compared to 59% in 2010/11. Similar improvement was observed in Wales where 59% in 2011/12 and 46% in 2010/11, and in Belfast where 84% compared to 72% in 2010/11, reached call-to-balloon within 120 minutes.

In England, 89% of patients taken directly to the Heart Attack Centre were treated with primary PCI within 150 minutes of...
calling for professional help compared to 51% of patients taken first to a local hospital and then transferred to a Heart Attack Centre. The equivalent figures for Wales were 79% for direct admissions and 73% for transfers and in Belfast 88% for direct admissions and only a small number of patients transferred to the Heart Attack Centre after prior assessment.

The proportion of patients admitted directly to a Heart Attack Centre who received primary PCI within 150 minutes of a call for professional help continues to improve [Figure 12]. There is a limit to how rapidly ambulance services can assess patients and transfer them safely to hospital. The scope for further improvement in this interval may be limited.

Figure 12. Percentage of patients with an admission diagnosis of STEMI having primary PCI within either 120 (CTB120) or 150 (CTB150) minutes from the time of calling for professional help admitted directly or transferred to the Heart Attack Centre

3. Hospitals using thrombolytic treatment

Thrombolytic treatment is now used infrequently in the management of heart attack. At present only 5% of all patients with STEMI [Figure 4] – less than 10% of those eligible for reperfusion treatment [Figure 10] – receive thrombolytic treatment, and this occurs mainly in a few areas where timely access to a Heart Attack Centre is not yet available. While thrombolysis is becoming the gold standard early treatment for acute stroke, its use in heart attack is diminishing.

The national standard for thrombolytic treatment is that it is given within 60 minutes of a call for professional help – the call-to-needle time. This is a joint responsibility of acute hospitals and ambulance services. The aim is for at least 68% of cases to achieve this standard in England, and 70% in Wales, though the reported figures are prone to wide variation – a few delayed treatments being very influential when the total number still receiving thrombolysis is small.

Tables 2 and 3 show hospital thrombolytic treatment analyses for 2010/11 and 2011/12 for England and Wales respectively. The Belfast hospitals did not report use of any thrombolytic treatment in 2011/12.

3.1 Door to needle time

In England, 61% of eligible patients received thrombolytic treatment within 30 minutes of arrival at hospital compared to 76% in 2010/11. In Wales 62% of eligible patients received treatment with 30 minutes compared to 63% in 2010/11.

3.2 Call to needle time

In England 54% of eligible patients receiving thrombolytic treatment did so within 60 minutes of calling for professional help compared to 69% in 2010/11. In Wales 48% of eligible patients received thrombolytic treatment within 60 minutes of calling for professional help compared to 53% in 2010/11.

3.3 Future of thrombolysis and its use in the rural areas

The apparent reduction in performance with respect to the delivery of thrombolysis, with fewer patients receiving treatment within the national door-to-needle and call-to-needle standards, largely reflects the shift in emphasis from thrombolysis to primary PCI. Those remaining patients receiving thrombolysis are likely to be those in whom there is diagnostic uncertainty, those who present when the local Heart Attack Centre is busy performing primary PCI for another patient, and those who live in more rural areas where there is no ready access to primary PCI.

While air ambulance helicopters have been used to transport patients from remote areas to Heart Attack Centres, their use is limited, and there are circumstances in which such flights are not feasible (e.g. adverse weather and night flying restrictions). For the foreseeable future there will still be a place for thrombolytic treatment in rural areas. There are particular challenges to maintaining a rapid, efficient and safe response to a small number of patients – if a treatment is not delivered frequently it is likely to be delivered with extra caution and therefore more slowly. The delivery of this treatment before arrival at hospital – pre-hospital thrombolysis – is one way of trying to reduce delay (see part three, case study 7).

However, even after thrombolytic treatment is given there is a need to be ready to transfer patients to a Heart Attack Centre (often many miles away), for emergency ‘rescue angioplasty’ in cases where thrombolysis proves ineffective, or for semi-urgent elective angiography and PCI – the recommended management following successful thrombolysis. Such
transfers require a significant amount of planning by ambulance services, and divert an ambulance from other emergency duties for prolonged periods.

3.4 PCI post thrombolysis

All patients with STEMI receiving primary PCI will necessarily undergo coronary angiography – the diagnostic investigation that produces images of the coronary arteries and allows identification of the ‘culprit’ artery responsible for the heart attack and the target for the PCI. Angiography, with a view to performing PCI (even coronary artery bypass grafting heart surgery) is also recommended in those patients who have received thrombolysis. It is also recommended in those patients who have presented with evidence of STEMI yet for various reasons (often because they present too late to benefit) do not receive immediate reperfusion therapy.

The use of angiography for patients with STEMI who did not receive primary PCI, but instead received thrombolytic treatment or who had no reperfusion treatment, has steadily risen, from 53% in 2007/8 to 72% this year [Figure 13]

Figure 13. Use of angiography for patients having STEMI who do not receive primary PCI, but instead received thrombolytic treatment or had no reperfusion treatment (England, Wales and Belfast)

4. Patients that received no reperfusion

While there has been a major shift in the preferred reperfusion therapy – from thrombolysis to primary PCI – there remains a substantial proportion of patients who have a final diagnosis of STEMI yet who do not receive reperfusion therapy at all; 30% in 2011/12, compared to 31% in 2010/11 (Figure 14).

The commonest reason why no reperfusion treatment is given is that the patient presents too late for treatment, which typically is not given more than 12 hours after onset of symptoms because of limited benefit by this time. In a small number of cases severe co-morbidity, such as advanced malignancy or severe dementia, may make reperfusion treatment inappropriate. In some cases the perceived risk of bleeding induced by thrombolysis, or by some of the medication given during primary PCI, is judged too high to allow such treatment. Largely these are matters for clinical judgement by individual clinicians when they first assess the patient.

However, the performance of angiography before an intended primary PCI may demonstrate features that indicate that PCI is not required [for example in cases of Takotsubo Cardiomyopathy, see section 3.4] or is not feasible. This can only be determined by angiography. Thus, angiography allows treatment to be offered only to those for whom benefit can be expected, and enables clinicians to exclude those where benefit is not anticipated. That being said, those who undergo timely emergency angiography in readiness for primary PCI, yet who do not proceed to PCI, will appear as ‘no reperfusion’ in this report.
5. Ambulance service performance

Ambulance services collaborate closely with receiving hospitals and networks to improve care. For many, the focus has shifted from provision of pre-hospital thrombolytic treatment to identifying those patients with heart attack who might benefit from primary PCI, and transferring them rapidly to a Heart Attack Centre. So, for many ambulance services, the number of patients receiving pre-hospital thrombolytic treatment has declined. Nevertheless, ambulance personnel continue to provide the essential earliest phase of cardiac care for patients with heart attack including resuscitation from sudden cardiac arrest, pain relief, (and where appropriate) oxygen therapy, drugs such as aspirin and clopidogrel, performance of diagnostic ECG and continuing cardiac monitoring. They are largely responsible for the early recognition of an ACS, its initial diagnosis and decisions as to which receiving hospital to alert. Their role in providing professional reassurance to patients and their relatives should not be underestimated (see part three, case study 4).

Table 6 shows ambulance service performance in England and Wales. In England in 2011/12, 210 patients received pre-hospital thrombolytic treatment compared to 824 in 2010/11. In Wales 154 patients received pre-hospital thrombolytic treatment compared to 219 in 2010/11.

Because the response of the ambulance service influences the call to balloon time of patients receiving primary PCI, Table 6 also contains information on call-to-balloon time for each ambulance Trust.

6. Use of secondary prevention medication

Use of secondary prevention medication after the acute event is proven to improve outcomes for patients. These benefits apply after both STEMI and nSTEMI.

NICE guidance\(^{19}\) recommends that all eligible patients who have had an acute heart attack should be offered treatment with a combination of the following drugs:

- ACE inhibitor
- aspirin
- beta blocker
- statin.

Table 7 shows the percentage of patients prescribed secondary prevention medication on discharge by hospital in England, Wales and Belfast in 2011/12. For each hospital those patients surviving to be discharged home from that hospital are included but those transferred to another hospital and those patients in whom such drugs were contraindicated are excluded. Historically, we have used the NSF audit standard of 80% for aspirin, beta blockers and statins treatment. There are no national standards for the prescription of ACE inhibitors and Clopidogrel/ thienopyridine inhibitors.

Use of secondary prevention medication at discharge from hospital is very satisfactory, continuing to exceed the national standards, and there is little room for further improvement [Figure 15]. In England prescription of aspirin was 99%, beta blockers 96%, statins 97%, ACE inhibitors 95% and Clopidogrel/thienopyridine inhibitors 96%. In Wales prescription of aspirin was 99%, beta blockers 96%, statins 96%, ACE inhibitors 90% and Clopidogrel/thienopyridine inhibitors 95%. In the Belfast hospitals prescription of aspirin was 100%, beta blockers 100%, statins 99%, ACE inhibitors 98% and Clopidogrel/thienopyridine inhibitors 99%.

**Figure 15. Use of secondary prevention medication**

All heart attacks, [transfers, deaths, contraindicated and patient refused are all excluded].

MINAP will revise its dataset at the end of 2012 to include the use of newer antiplatelet medication; however it is likely to be another two years before sufficient data is available to provide reliable reports.

7. Cardiac Networks

Cardiac Networks (also known as ‘heart and stroke networks’ since they also now facilitate improvements in stroke care) are local NHS organisations that seek to improve the way that services are planned and delivered. Bringing together clinicians, managers, commissioners and patients, and aware of the entire ‘cardiac pathway’, the networks can provide a powerful voice in the local health economy to enable frontline staff to secure the changes needed to deliver best care. They provide a forum through which the public can influence their services. Some Cardiac Networks have patient carer representatives providing a voice among the professionals.

Table 8 shows the performance of the call-to-needle and call-to-balloon targets and the percentage of patients that received pre-hospital thrombolytic treatment, in-hospital thrombolytic treatment and primary PCI by Cardiac Network. The two Cardiac Networks in Wales are shown separately.

There are 28 Cardiac and Stroke Networks in England and two in Wales. The purpose of the analyses at this level, amongst others, is to highlight issues relating to equality of access to optimal patient care. Figure 16 shows the rate of primary PCIs performed within each Cardiac Network (based on postcode of patient’s residence). It is important to note that some patients are now treated across their network’s boundaries – if their nearest Heart Attack Centre lies outside this boundary.

Countrywide access to primary PCI remains incomplete, although the picture is changing rapidly. The percentage of patients in English Cardiac Networks that received primary PCI ranged between 42-99% and in 2 Cardiac Networks less than 50% of their patients received primary PCI. In Wales primary PCI services are currently only routinely available at the South Wales Cardiac Network (Rhwydwaith y Galon De Cymru).

**Figure 16 (right). Number of primary PCIs per million population by Cardiac Network**
8. Care for patients with nSTEMI

The earliest MINAP reports focussed upon the early provision of reperfusion treatment to those patients presenting with STEMI. Patients with nSTEMI have a lower early risk of death and, perhaps because they do not require very rapid emergency treatment (reperfusion therapy), they are not always admitted to cardiac care units, nor always cared for by cardiologists. However, specialist involvement is important in determining the likelihood of receiving ‘evidence-based’ treatments such as coronary angiography and revascularisation. It is recognised that performance of angiography and coronary intervention is an important facet of treatment for most patients (see below). Ideally admission should be to a cardiac facility (where nursing staff have expertise in cardiac nursing and there is easy access to cardiological expertise).

As mentioned above the numbers of nSTEMI reported in MINAP are incomplete, and in particular it is likely that patients who are not admitted to a cardiac care unit are omitted. The quality of care for patients not entered into MINAP remains unknown. In addition the variable nature of recording nSTEMI between hospitals may distort some analyses.

Table 9 shows the percentage of nSTEMI patients that were admitted to a cardiac unit or ward and the percentage of nSTEMI patients seen by a cardiologist or member of their team, by hospital, in 2010/11 and 2011/12. Similar analyses for hospitals in Wales and Belfast are shown in Table 10. In England in 2011/12 51% of nSTEMI patients were admitted to a cardiac care unit or ward compared with 50% in 2010/11. In Wales 64% of patients were admitted to a cardiac unit or ward compared to 59% in 2010/11. In the Belfast hospitals, 87% of patients were admitted to a cardiac unit or ward compared to 81% in 2010/11.

In England in 2011/12, 93% of nSTEMI patients were seen by a cardiologist, or member of the cardiologist’s team, compared to 91% in 2010/11. In Wales 81% of nSTEMI patients were seen by a cardiologist or member of their team compared to 84% in 2010/11. In the Belfast hospitals 100% of nSTEMI patients were seen by a cardiologist or member of their team compared to 99% in 2010/11.

The frequency with which patients are referred for angiography for nSTEMI also continues to increase – from 53% in 2007/8 to 76% in 2011/12 (Figure 18). Tables 9 and 10 show the percentage of nSTEMI that were referred for angiography by hospital in 2010/11 and 2011/12. In 2011/12, 69% of nSTEMI patients in England were referred for angiography after nSTEMI, and 63% in 2010/11. In Wales 74% were referred in 2011/12, and 71% in 2010/11. In Belfast 91% were referred in 2011/12 and 82% in 2010/11.

This year we report on the interval between admission and performance of angiography. While immediate angiography is not warranted in the vast majority of patients with nSTEMI, early angiography is recommended for those at moderate to high risk. The maximum acceptable delay from admission to angiogram has been variously defined. So, for example the European Society of Cardiology suggests a 72 hour maximum, while NICE suggests a 96 hour maximum. Figure 17 shows a general improvement over the last year. Between 2010/11 and 2011/12 the proportion of patients receiving angiography within 24 hours of admission increased from 21% to 22%; within 72 hours from 55% to 58%; and within 96 hours from 67% to 71%. However, 29% of patients with nSTEMI who receive an angiogram do so after the maximum recommended time interval (i.e. 96 hours) compared to 33% in 2010/11.

9. Change in mortality of heart attack patients

Figure 19. 30 day mortality (with 95% confidence limits around the point estimate within each year) for all patients having STEMI

Over the last 8 years there have been gradual reduction in the reported death rates for patients within the MINAP dataset, both those with a final diagnosis of STEMI (Figure 19) and nSTEMI (Figure 20).
Primary PCI within 90 minutes of arrival reflects the ability of hospital to provide treatment in a timely manner. Primary PCI within 150 minutes of calling for help reflects hospital performance and that of the emergency services in identifying STEMI and taking the patient to the Heart Attack Centre (which may not be the closest hospital). Not all patients are taken directly to a Heart Attack Centre, especially where there is a diagnostic uncertainty. This inevitably takes longer than direct transfer, but cannot be avoided in some cases.

**Table 1: Primary PCI in hospitals in England, Wales and Belfast**

Primary PCI within 90 minutes of arrival reflects the ability of hospital to provide treatment in a timely manner. Primary PCI within 150 minutes of calling for help reflects hospital performance and that of the emergency services in identifying STEMI and taking the patient to the Heart Attack Centre (which may not be the closest hospital). Not all patients are taken directly to a Heart Attack Centre, especially where there is a diagnostic uncertainty. This inevitably takes longer than direct transfer, but cannot be avoided in some cases.

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10. Results by hospitals, ambulance services and cardiac networks - percentages are not shown for less than 20 cases
<p>| Hospital Name                                      | 63   | 90% | 56   | 80% | 54   | 83% | 2    | 56   | 61% | 95% | 87   | 90% | 84   | 86%  | 73   | 92% | 11   | 84   | 70% | 85% | 29MINAP |
|---------------------------------------------------|------|-----|------|-----|------|-----|------|------|-----|-----|------|-----|------|-----|-----|-----|------|-----|-----|------|------|-----|------|
| Conquest Hospital, St Leonards on Sea             | 52   |     | 50   | 90% | 49   | 90% | 1    | 50   | 68% | 98% | 11   | 84  | 70%  | 85%  | 44% | 50% | 44% | 50%  | 44% | 50% |
| Croydon University Hospital, Croydon               | 1    |     | 0    | 0   | 0    | 0   | 0    | 0    | 0   | 0   | 0    | 0   | 0    | 0   | 0   | 0   | 0    | 0    | 0   | 0    | 100% |
| Darent Valley Hospital, Dartford                   | 6    | 3   | 3    | 0   | 3    | 100%| 0    | 3    | 100%| 0   | 3    | 100%| 0    | 3    | 100%| 0   | 3    | 100%| 0   | 3    | 100%|
| Derriford Hospital, Plymouth                       | 138  | 80% | 136  | 77% | 136  | 77% | 0    | 136  | 55% | 100%| 0    | 136  | 55%  | 100%| 0    | 136  | 55% | 100%| 0    | 136  | 55% | 100%|
| Dorset County Hospital, Dorchester                 | 26   | 88% | 25   | 80% | 25   | 80% | 0    | 25   | 60% | 100%| 0    | 25   | 60%  | 100%| 0    | 25   | 60% | 100%| 0    | 25   | 60% | 100%|
| Eastbourne DGH, Eastbourne                         | 39   | 62% | 32   | 69% | 32   | 69% | 0    | 32   | 41% | 100%| 0    | 32   | 41%  | 100%| 0    | 32   | 41% | 100%| 0    | 32   | 41% | 100%|
| Frenchay Hospital, Bristol                         | 766  | 98% | 656  | 91% | 529  | 98% | 127  | 62% | 656  | 83% | 70%  | 832  | 98%  | 713  | 94% | 631  | 98% | 83   | 59%  | 713  | 87% | 76% | 20MINAP |
| Freeman Hospital, Newcastle                        | 26   | 88% | 25   | 80% | 25   | 80% | 0    | 25   | 60% | 100%| 0    | 25   | 60%  | 100%| 0    | 25   | 60% | 100%| 0    | 25   | 60% | 100%|
| Frontier Park Hospital, Frimley                    | 329  | 86% | 232  | 85% | 227  | 87% | 5    | 232  | 64% | 92% | 349  | 89%  | 307  | 86% | 306  | 86% | 1    | 307  | 86% | 306  | 86% | 97% | 32MINAP |
| Hammersmith Hospital, London                       | 329  | 89% | 293  | 74% | 184  | 90% | 109  | 48% | 293  | 58% | 65%  | 800  | 95%  | 775  | 91% | 553  | 98% | 239  | 75%  | 775  | 68% | 69% | 33MINAP |
| Harrowfield Hospital                               | 348  | 93% | 329  | 79% | 240  | 93% | 89  | 40% | 329  | 61% | 72%  | 344  | 96%  | 315  | 86% | 264  | 94% | 52   | 44%  | 315  | 71% | 80% | 34MINAP |
| James Cook University Hospital, Middlesborough     | 102  | 83% | 93   | 87% | 92   | 88% | 1    | 93   | 60% | 99% | 101  | 86%  | 93   | 88% | 92   | 88% | 1    | 93   | 60% | 99% | 101  | 86%  | 93   | 88% | 92   | 88% |
| John Radcliffe Hospital, Oxford                    | 1034 | 84% | 823  | 64% | 650  | 76% | 173  | 21% | 823  | 35% | 68%  | 1058 | 88%  | 880  | 66% | 668  | 82% | 212  | 17%  | 880  | 43% | 65% | 10MINAP |
| Kettering General Hospital, Kettering              | 11   | 11  | 11   | 0   | 1    | 100%| 0    | 11   | 100%| 0   | 11   | 100%| 0    | 11   | 100%| 0   | 11   | 100%| 0   | 11   | 100%| 0   | 11   | 100%|
| King’s College Hospital, London                    | 78   | 94% | 69   | 93% | 63   | 95% | 6    | 69   | 87% | 87% | 90   | 97%  | 82   | 98% | 79   | 97% | 3    | 82   | 88% | 93% | 78MINAP |
| Leeds General Infirmary, Leeds                     | 677  | 97% | 605  | 82% | 362  | 98% | 244  | 57% | 605  | 65% | 58%  | 798  | 98%  | 641  | 82% | 429  | 98% | 212  | 50%  | 641  | 66% | 55% | 67MINAP |
| Lincoln County Hospital, Lincoln                   | 331  | 89% | 253  | 74% | 172  | 88% | 81   | 43% | 253  | 53% | 55%  | 521  | 86%  | 435  | 64% | 289  | 83% | 144  | 26%  | 435  | 39% | 57% |
| Medway Maritime Hospital, Gillingham               | 10   | 10  | 10   | 0   | 10   | 100%| 12   | 11  | 11   | 0   | 100%| 11   | 100%| 11   | 100%| 11   | 100%| 11   | 100%| 11   | 100%| 11   | 100%|
|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|                   | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       | n       | %       |
| Musgrove Park Hospital, Taunton | 158 | 99% | 147 | 98% | 125 | 98% | 22 | 100 | 147 | 88% | 174 | 100% | 166 | 96% | 149 | 97% | 17 | 166 | 84% | 90% |
| New Cross Hospital, Wolverhampton | 498 | 91% | 383 | 81% | 324 | 89% | 59 | 36% | 383 | 62% | 476 | 88% | 376 | 81% | 338 | 88% | 38 | 16% | 376 | 58% | 77% |
| Norfolk and Norwich University Hospital, Norwich | 402 | 96% | 389 | 86% | 357 | 89% | 32 | 53% | 389 | 58% | 413 | 96% | 400 | 90% | 373 | 91% | 27 | 78% | 400 | 62% | 92% |
| Northampton General Hospital, Northampton | 36 | 92% | 28 | 96% | 28 | 96% | 0 | 79% | 28 | 9% | 100% | 20 | 90% | 14 | 100% | 14 | 0 | 14 | 100% |
| Northern General Hospital, Sheffield | 607 | 88% | 573 | 75% | 578 | 75% | 4 | 75% | 573 | 48% | 99% | 595 | 87% | 546 | 74% | 393 | 84% | 153 | 48% | 56 | 48% | 69% |
| Northwick Park Hospital, Harrow | 3 | 3% | 3 | 3% | 0 | 79% | 3 | 100% | 2 | 0 | 0 | 0 | 0 | 100% |
| Nottingham City Hospital, Nottingham | 189 | 96% | 177 | 86% | 166 | 90% | 11 | 7% | 177 | 74% | 92% | 355 | 96% | 320 | 82% | 304 | 84% | 16 | 320 | 70% | 93% |
| Papworth Hospital, Cambridge | 420 | 98% | 410 | 76% | 295 | 90% | 115 | 39% | 410 | 47% | 71% | 441 | 97% | 425 | 70% | 346 | 79% | 80 | 30% | 425 | 45% | 81% |
| Pinderfields General Hospital, Wakefield | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 1 | 1% | 1 | 1% | 1 | 1% | 0 | 1% | 1 | 1% | 100% |
| Queen Alexandra Hospital, Portsmouth | 193 | 88% | 177 | 81% | 138 | 91% | 39 | 44% | 177 | 54% | 78% | 372 | 79% | 330 | 77% | 242 | 82% | 88 | 64% | 330 | 53% | 72% |
| Queen Elizabeth Hospital, Birmingham | 124 | 68% | 110 | 74% | 107 | 76% | 3 | 45% | 110 | 45% | 93% | 221 | 92% | 203 | 92% | 205 | 92% | 0 | 205 | 73% | 100% |
| Royal Berkshire Hospital, Reading | 147 | 96% | 134 | 95% | 134 | 95% | 0 | 7% | 134 | 8% | 100% | 166 | 92% | 144 | 96% | 146 | 96% | 0 | 146 | 90% | 100% |
| Royal Blackburn Hospital, Blackburn | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 5 | 1% | 1 | 1% | 1 | 1% | 0 | 1% | 1 | 1% | 100% |
| Royal Bournemouth General Hospital, Bournemouth | 72 | 92% | 68 | 96% | 63 | 95% | 5 | 7% | 68 | 76% | 93% | 70 | 79% | 64 | 80% | 63 | 81% | 1 | 64 | 62% | 98% |
| Royal Brompton Hospital, London | 1 | 1% | 0 | 0% | 1 | 1% | 0 | 0% | 1 | 1% | 0 | 0% | 5 | 6% | 6 | 11% | 11 | 38% |
| Royal Cornwall Hospital, Truro | 33 | 97% | 33 | 94% | 32 | 94% | 1 | 3% | 33 | 67% | 97% | 185 | 88% | 177 | 82% | 175 | 82% | 2 | 177 | 52% | 99% |</p>
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“During times of financial constraint there is a temptation to reduce investment in such exercises, even though participation in clinical audit is mandated by the Department of Health and Welsh Government. Conversely, we would argue that such conditions—a working environment characterised by cost containment and efficiency—increase, rather than decrease, the need for reliable contemporary knowledge of hospital performance.”

Dr Clive Weston
Clinical Director of MINAP
### Table 2: Thrombolytic treatment in hospitals in England

This table presents results for hospitals that administered thrombolytic treatment to patients with admission diagnosis of STEMI. ‘n’ represents number of all eligible patients for this type of reperfusion.

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<th>2011/12</th>
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</tr>
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</tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>Value</td>
<td>Value</td>
</tr>
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<td>18</td>
</tr>
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<tr>
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<td>0</td>
</tr>
<tr>
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<td>2</td>
</tr>
<tr>
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</tr>
<tr>
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<td>14</td>
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<tr>
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<td>18</td>
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<tr>
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</tr>
<tr>
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<td>7</td>
</tr>
<tr>
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<td>2</td>
</tr>
<tr>
<td>The Great Western Hospital, Swindon</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Year</td>
<td>Thrombolytic treatment within 30 mins of hospital arrival</td>
<td>Thrombolytic treatment within 60 mins of calling for help</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
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<td>0</td>
</tr>
<tr>
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<td>1</td>
</tr>
<tr>
<td>University Hospital Aintree, Liverpool</td>
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<td>2</td>
</tr>
<tr>
<td>University Hospital Coventry, Coventry</td>
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<td>3</td>
</tr>
<tr>
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<td>0</td>
</tr>
<tr>
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<td>1</td>
</tr>
<tr>
<td>University Hospital of North Tees, Stockton on Tees</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>University Hospital Queen’s Medical Centre, Nottingham</td>
<td>27</td>
<td>74%</td>
</tr>
<tr>
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<td>4</td>
</tr>
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<td>0</td>
</tr>
<tr>
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<td>5</td>
<td>0</td>
</tr>
<tr>
<td>West Cumberland Hospital, Whitehaven</td>
<td>36</td>
<td>81%</td>
</tr>
<tr>
<td>West Suffolk Hospital, Bury St Edmunds</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wexham Park Hospital, Slough</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Whiston Hospital, Prescott</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>William Harvey Hospital, Ashford</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Worcestershire Royal Hospital, Worcester</td>
<td>29</td>
<td>83%</td>
</tr>
<tr>
<td>Worthing Hospital, Worthing</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Hospital Name</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Wycombe Hospital, High Wycombe</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Wythenshawe Hospital, Manchester</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Yeovil District Hospital, Yeovil</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>York District Hospital, York</td>
<td>2</td>
<td>1</td>
</tr>
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</table>
Table 3: Thrombolytic treatment in hospitals in Wales and Belfast

This table presents results for hospitals that administered thrombolytic treatment to patients with admission diagnosis of STEMI. ‘n’ represents number of all eligible patients for this type of reperfusion.

<table>
<thead>
<tr>
<th>Year</th>
<th>2010/11</th>
<th>2011/12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td><strong>Wales: Overall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>63%</td>
<td>398</td>
</tr>
<tr>
<td>Bronglais General Hospital, Aberystwyth</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Glan Clwyd Hospital, Rhyl</td>
<td>30</td>
<td>97%</td>
</tr>
<tr>
<td>Llandough Hospital, Llandough</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Llandudno General Hospital, Llandudno</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Morriston Hospital, Swansea</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Neath Port Talbot Hospital, Neath</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Nevill Hall Hospital, Abergavenny</td>
<td>29</td>
<td>66%</td>
</tr>
<tr>
<td>Prince Charles Hospital, Merthyr Tydfil</td>
<td>23</td>
<td>61%</td>
</tr>
<tr>
<td>Prince Philip Hospital, Llanelli</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Princess Of Wales Hospital, Bridgend</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>Royal Glamorgan, Llantrisant</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Royal Gwent Hospital, Newport</td>
<td>40</td>
<td>60%</td>
</tr>
<tr>
<td>University Hospital of Wales, Cardiff</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>West Wales General Hospital, Camarthen</td>
<td>30</td>
<td>70%</td>
</tr>
<tr>
<td>Withybush General Hospital, Haverfordwest</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Wrexham Maelor Hospital, Wrexham</td>
<td>47</td>
<td>64%</td>
</tr>
<tr>
<td>Ysbyty Gwynedd, Bangor</td>
<td>33</td>
<td>45%</td>
</tr>
<tr>
<td><strong>Belfast: Overall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mater Infirmorum Hospital, Belfast</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Royal Victoria Hospital, Belfast</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
"I know that MINAP data has been the spur to improve data input quality, thus enabling valid comparisons to be made, leading to direct improvements in performance. Would we, for instance, have seen direct admittance to cath labs become accepted practice so quickly without the influence of comparative clinical data? Would there be confidence in the evidence to support the decisions made over primary PCI without MINAP?"

Alan Keys
Patient representative for MINAP
Table 4: Reperfusion treatment in England

This table shows the proportion of all patients with discharge diagnosis of STEMI that received either in-hospital thrombolytic treatment or primary PCI. ‘n’ represents number of patients that received either thrombolytic treatment or primary PCI. 30% of patients received no reperfusion compared to 31% in 2010/2011.

<table>
<thead>
<tr>
<th>Year</th>
<th>Patients that received thrombolytic treatment</th>
<th>Patients that received primary PCI</th>
<th>Patients that received thrombolytic treatment</th>
<th>Patients that received primary PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>England: Overall</td>
<td>3461</td>
<td>17.8%</td>
<td>15942</td>
<td>82.2%</td>
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<td>Addenbrooke’s Hospital, Cambridge</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Airedale General Hospital, Skipton</td>
<td>8</td>
<td>100%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alexandra Hospital, Redditch</td>
<td>61</td>
<td>100%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arrowe Park Hospital, Wirral</td>
<td>30</td>
<td>100%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Barnsley Hospital, Barnsley</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Barts and the London, London</td>
<td>1</td>
<td>557</td>
<td>99.8%</td>
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<td>Basildon Hospital, Basildon</td>
<td>43</td>
<td>6.8%</td>
<td>587</td>
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<td>119</td>
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<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bedford Hospital, Bedford</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Birmingham City Hospital, Birmingham</td>
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<td>100%</td>
<td>2</td>
</tr>
<tr>
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<td>332</td>
<td>99.4%</td>
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<td>171</td>
<td>96.1%</td>
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</tr>
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<td>6</td>
<td>2</td>
<td>7</td>
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</tr>
<tr>
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<td>3</td>
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</tr>
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<td>Deaths</td>
<td>Survivals</td>
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</tr>
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<td>100%</td>
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<td>0</td>
<td>0</td>
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<td>10</td>
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<td>1</td>
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<td>0</td>
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<td>2</td>
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<td>0</td>
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</tr>
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</tr>
<tr>
<td>Hospital Name</td>
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<td>Patients that received primary PCI n</td>
<td>%</td>
</tr>
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<td>--------------</td>
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<td>-------------------------------------</td>
<td>----------</td>
</tr>
<tr>
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<td>338</td>
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<td>99.7%</td>
</tr>
<tr>
<td>Harefield Hospital</td>
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<td>623</td>
<td>0</td>
<td>99.5%</td>
</tr>
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<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hillingdon Hospital, Uxbridge</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hinchingbrooke Hospital, Huntingdon</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Horton General Hospital, Banbury</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Huddersfield Royal Infirmary, Huddersfield</td>
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<td>4</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>99.8%</td>
</tr>
<tr>
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<td>8</td>
<td>96.6%</td>
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“MINAP, and its long history, is a testament to the huge efforts of all those responsible: staff and hospitals collecting the data, data managers and analysts, researchers and publishers.”

Professor Huon Gray
Interim National Clinical Director for Cardiovascular Disease (England)
Table 5: Reperfusion treatment in Wales and Belfast

This table shows the proportion of all patients with discharge diagnosis of STEMI that received either in-hospital thrombolytic treatment or primary PCI. ‘n’ represents number of patients that received either thrombolytic treatment or primary PCI. In Wales 27% of patients received no reperfusion in 2011/12 compared to 31% in 2010/11. In Belfast 29% of patients received no reperfusion compared to 30% in 2010/11.

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### Table 6: Ambulance Services in England, Wales and Belfast

This table presents results of 12 Ambulance NHS Trusts in England. Wales is served by Welsh Ambulance Services NHS Trust that covers the entire region. ‘n’ represents all patients that meet inclusion criteria for each analysis.

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Table 7: Secondary prevention medication

These analyses are based on all patients discharged from hospital with a diagnosis of myocardial infarction. Patients are excluded if they are transferred from the admitting hospital to another hospital for further treatment. Patients are also excluded from analyses if there is a contraindication to a drug, if they refuse treatment, or have severe non cardiac co-morbidity that limits prognosis. 'n' represents number of patients that received relevant secondary prevention medication.

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<p>| Maidstone Hospital, Maidstone | 130     | 93%          | 122           | 81%     | 124                                  | 83% |
| Manchester Royal Infirmary, Manchester | 339     | 99%          | 337           | 92%     | 341                                  | 92% |
| Manor Hospital, Walsall | 60      | 97%          | 55            | 84%     | 60                                    | 83% |
| Medway Maritime Hospital, Gillingham | 324     | 100%         | 321           | 99%     | 314                                  | 99% |
| Milton Keynes General Hospital, Milton Keynes | 38      | 95%          | 38            | 84%     | 39                                    | 85% |
| Montagu Hospital, Mexborough | 4       | 1            | 2             |         | 4                                     | 3   |
| Musgrove Park Hospital, Taunton | 416     | 98%          | 412           | 90%     | 405                                  | 90% |
| New Cross Hospital, Wolverhampton | 885     | 100%         | 716           | 99%     | 748                                  | 99% |
| Newark Hospital, Newark | 1       | 1            | 1             |         | 1                                     | 1   |
| Newham General Hospital, London | 86      | 100%         | 72            |         | 63                                    | 100%|
| Norfolk and Norwich University Hospital, Norwich | 1156    | 99%          | 1024          | 100%    | 1085                                 | 100%|
| North Devon District Hospital, Barnstable | 143     | 100%         | 104           | 100%    | 124                                  | 98% |
| North Manchester General Hospital, Manchester | 211     | 100%         | 192           | 99%     | 192                                  | 97% |
| North Middlesex Hospital, London | 56      | 91%          | 57            | 81%     | 57                                    | 82% |
| North Tyneside General Hospital, North Shields | 100     | 99%          | 87            | 95%     | 77                                    | 97% |
| Northampton General Hospital, Northampton | 355     | 100%         | 296           | 100%    | 280                                  | 100%|
| Northern General Hospital, Sheffield | 803     | 99%          | 688           | 99%     | 683                                  | 99% |
| Northwick Park Hospital, Harrow | 357     | 99%          | 298           | 84%     | 338                                  | 83% |
| Nottingham City Hospital, Nottingham | 452     | 100%         | 428           | 100%    | 425                                  | 99% |</p>
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**Wales: Overall**

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“We have participated in MINAP from its inception. By doing so we believe that we have been forced to look critically at our practice to ensure we meet nationally agreed targets and optimise the outcomes for our patients.”

Amelia Hilton - Clinical Audit Co-ordinator
(Pathology, Imaging and Medicine)
Sandwell West Birmingham Hospitals NHS Trust
Table 8: Cardiac networks in England, Wales and Belfast

This table presents results for Cardiac Networks in England, Wales as well as results for Belfast hospitals. Results for call-to-balloon within 120 and 150 minutes include all patients irrespective of their method of admission (direct admissions and transferred to a Heart Attack Centre). The thrombolytic treatment within 60 minutes analyses include all patients that received either pre-hospital or in-hospital thrombolysis.

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This table presents results for Cardiac Networks in England, Wales as well as results for Belfast hospitals. Results for call-to-balloon within 120 and 150 minutes include all patients irrespective of their method of admission (direct admissions and transferred to a Heart Attack Centre). The thrombolytic treatment within 60 minutes analyses include all patients that received either pre-hospital or in-hospital thrombolysis.
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“Participation in MINAP has helped to strengthen the partnerships East Midlands Ambulance Service has with local hospital trusts. This has benefited our cardiac patients as working together with the hospitals has helped us to identify areas of care which could be improved.”

Deborah Shaw – Clinical Audit and Research Manager East Midlands Ambulance Service
It is recognised that not all nSTEMI are entered into MINAP. A number of hospitals report lack of resources to collect data on nSTEMI, and more generally those patients not admitted to cardiac unit are less likely to be entered. Thus the percentages reported below do not take into account every patient admitted to hospital with nSTEMI but only reflect those entered in the MINAP database. ‘n’ represents number of patients that were seen by cardiologist, were admitted to a cardiac ward or were referred for or had angiography.

Table 9: Care of patients with non-ST-elevation infarction (nSTEMI) in England

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<th>2011/12</th>
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<td>33 19%</td>
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<td>51 100%</td>
<td>23 45%</td>
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<td>137 74%</td>
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<td>433 98%</td>
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<td>Percentage of 1%</td>
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<td>104</td>
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<td>95</td>
<td>57%</td>
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<td>141</td>
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<td>44</td>
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<td>29</td>
<td>22%</td>
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<td>90%</td>
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<tr>
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<td>71%</td>
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<td>96%</td>
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<td>271</td>
<td>98%</td>
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</tbody>
</table>
It is recognised that not all nSTEMI are entered into MINAP. A number of hospitals report a lack of resources to collect data on nSTEMI, and more generally those patients not admitted to a cardiac unit are less likely to be entered. Thus the percentages reported below do not take into account every patient admitted to hospital with nSTEMI but only reflect those entered in the MINAP database. ‘n’ represents number of patients that were seen by cardiologist, were admitted to a cardiac ward or were referred for or had angiography.

<table>
<thead>
<tr>
<th></th>
<th>2010/11 n</th>
<th>2011/12 n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td><strong>Wales: Overall</strong></td>
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<tr>
<td>nSTEMI patients seen</td>
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</tr>
<tr>
<td>by a cardiologist or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a member of team</td>
<td></td>
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<tr>
<td>nSTEMI patients that</td>
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<td>2011/12</td>
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<tr>
<td>admitted to</td>
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<td></td>
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<tr>
<td>cardiac unit or ward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nSTEMI patients that</td>
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<tr>
<td>referred for or had</td>
<td></td>
<td></td>
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<tr>
<td>angiography</td>
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<table>
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<th>nSTEMI patients admitted</th>
<th>nSTEMI patients that were referred for or had angiography</th>
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<td></td>
<td>124</td>
<td>123</td>
<td>94</td>
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<td>55</td>
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<td>37%</td>
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<tr>
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<td>1</td>
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<tr>
<td></td>
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<td>76%</td>
<td>82%</td>
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<tr>
<td></td>
<td>163</td>
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<td></td>
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<td></td>
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<td>59</td>
<td>46</td>
<td>36</td>
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<tr>
<td></td>
<td>100%</td>
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<td></td>
<td>154</td>
<td>127</td>
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<td>50</td>
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<tr>
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<tr>
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<td></td>
<td>158</td>
<td>130</td>
<td>71%</td>
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<td>72%</td>
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<td>109</td>
</tr>
<tr>
<td>Mater Infirmorum Hospital, Belfast</td>
<td>123</td>
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11. Difference in performance between England and Wales

In previous annual reports we have commented on differences in performance between Wales and England. These differences, which are becoming less obvious, have been felt to reflect the largely rural nature of Wales, and the effect this has had on the configuration of cardiac services. The shift from thrombolytic therapy to primary PCI has occurred more slowly in Wales than in most (but not all) of the English regions, and while a patient with STEMI is more likely to receive either form of reperfusion therapy (primary PCI or thrombolysis) in Wales than in England they are far less likely to undergo primary PCI (50% vs. 95% of all reperfusion), particularly in North Wales. However the two Welsh Cardiac Networks are working closely with the Welsh Ambulance Service and local hospitals to develop management strategies that promote the use of primary PCI, and pre-hospital thrombolysis in more geographically remote areas. This is the first year in which the majority of patients receiving reperfusion therapy underwent primary PCI. Two Heart Attack Centres in the South of Wales (in Swansea and Cardiff) are now able to offer continuous availability of primary PCI to their local populations, and have been increasing access for more distant populations. Also, a few patients have received primary PCI opportunistically at Ysbyty Glan Clwyd in the North of Wales.

The number of patients receiving primary PCI has therefore increased from 301 in 2010/11 to 528 this year – an increase of 75% in the number of patients so treated. Gratifyingly the proportion of these patients admitted directly to the heart attack centres is similar to the pattern seen in England as a whole, and the proportion of patients treated within 150 minutes and 120 minutes of calling for help is also similar (call-to-balloon within 150 minutes: 78% vs. 83%; call-to-balloon within 120 minutes: 59% vs. 62% in Wales and England respectively).

In keeping with best practice, most (74 %) of those who receive thrombolytic treatment for STEMI, or have no reperfusion treatment at all, subsequently undergo coronary angiography.

We remain concerned that some of the Welsh hospitals are not submitting data on the management they provide to patients with nSTEMI (the commonest type of acute coronary syndrome). This weakens the capacity of the National Audit to assure good quality care is being delivered. It may also explain the variation in outcome with respect to annual 30-day mortality for Welsh patients with nSTEMI (Figure 20). Participation is likely to improve as Health Boards respond to recent Welsh Government documents that re-emphasise the imperative to participate in national audits (including MINAP) as part of Quality Assurance and Quality Improvement initiatives.

The use of secondary preventive medication remains good and equivalent to English hospitals.

Reassuringly, in 2011/12 the 30-day mortality rates for both STEMI and nSTEMI are similar for patients in Wales and England.

Figure 21. 30 day mortality (with 95% confidence limits around the point estimate within each year) for STEMI in England and Wales

![Figure 21](image1)

Figure 22. 30 day mortality (with 95% confidence limits around the point estimate within each year) for nSTEMI in England and Wales

![Figure 22](image2)
1. Call activation system for primary PCIs

Michelle Holt - Senior Sister, CCU Sandwell
Sandwell West Birmingham Hospitals NHS Trust

When primary PCI first became continuously available – a 24 hour service, 7 days a week (24/7) – once an ‘alert call’ was received from A&E, staff on the Cardiac Care Unit (CCU) had to contact each member of the on-call PCI team individually to call them to the cardiac catheter (angiography) laboratory. This was often time-consuming and sometimes frustrating, particularly when occasionally the call was not answered immediately and voicemail-messaging services needed to be activated. This would cause small but significant delays to a service that was intended to provide rapid intervention. Consequently we developed our current PCI activation system. This simply requires the CCU staff to click on the appropriate computer icon, which is available on all CCU computers. On entering a code and activating the call all on-call staff receive a simultaneous mobile telephone alert, informing them all that there is a patient requiring primary PCI. Each member of the on-call team then enter a response code. This confirms to CCU that they have received and accepted the call, are on their way, and records an estimated time of arrival. This system has proved to be easy to use and much more convenient for all concerned. Delays to catheter lab access have reduced.

Staff at CCU

2. Streamlining MINAP data collection

Amelia Hilton - Clinical Audit Co-ordinator (Pathology, Imaging and Medicine)
Sandwell West Birmingham Hospitals NHS Trust

We have participated in MINAP from its inception. By so doing we believe that we have been forced to look critically at our practice to ensure we meet nationally agreed targets and optimise the outcomes for our patients.

Over the years, we have changed not only the way we manage heart attack but also our approach to collecting data. We would like to share our ‘best practice’, with the MINAP community, of a data collection process that takes minimal time, while remaining highly accurate; inaccurate data isn’t worth collecting.

Our A&E, CCU, Catheter laboratory and Clinical Effectiveness (audit) department, work together to get the best out of MINAP. Cases are identified mainly via CCU, as the majority of patients with chest pain are admitted to this ward (unless they require ITU admission, e.g. out of hospital cardiac arrest). Because the CCU staff start a MINAP form during the admission process, all the information available whilst the patient is on the ward. They also photocopy relevant parts from case notes (i.e. ambulance sheet, ‘Casualty card’, ECGs, patient ward admission form, Catheter lab procedure report) and attach these to the MINAP form.

Dedicated ‘MINAP champions’, on each hospital site (mainly senior staff nurses, ward managers and selected cardiology consultants) help check forms. We ensure all cases were correctly identified for the month and a form for each eligible patient is completed. We examine the BCIS database (i.e. a list of all non-elective PCI cases). The forms then come to the Clinical Effectiveness department where the Clinical Audit Co-ordinator for Medicine assesses each for accuracy, using the copied information from notes, CDA (clinical data archive) electronic patient records (i.e. GP details, patient demographics, test results, ward activity, discharge summary and any referrals for surgery), Ambulance data downloads and BCIS database. It may sound extensive, but, having all three databases open simultaneously allows a quick scan through the form and electronic data to ensure all fields were completed correctly. It only takes me about 5mins. Our trust has around 60-70 MINAP eligible cases per month. With this process I’m able to verify data quality and input data onto NICOR via Lotus notes within one week. We hold a MINAP meeting each month to discuss any queries and to learn from any cases with a delay in reperfusion time. Minutes of this meeting are circulated to all cardiology staff.
Once entered centrally, the full monthly dataset is exported and saved in an Excel spreadsheet for each hospital site. These MINAP dataset exports have proved useful to audit specific parts of the chest pain pathway and to demonstrate secondary prevention drug use in line with NICE guidance. It’s truly useful to download your dataset every month. With the MINAP data we are also able to report to the trust Planning & Performance Management department as well as the Information department with regards to PCI trends.

MINAP can be daunting, but once you’ve streamlined a system that works, it holds great benefit for the Trust and for clinicians and can be useful in many ways. Our Trust is proud to be part of the MINAP community.

Example of MINAP dataset export
3. Implementing a high-risk nSTEACS pathway across London as part of the London Cardiovascular Project

Sotiris Antoniou - Consultant Pharmacist, Barts & the London NHS Trust, North-East London Cardiovascular and Stroke Network
Sue Sawyer - Assistant Director of North-East London Cardiovascular and Stroke Network
Janet Lailey - Director of North-East London Cardiovascular and Stroke Network

On behalf of the London NSTEACS working group (Cardiac and Stroke network).

Whilst primary PCI is recommended as the treatment of choice for patients with ST-elevation myocardial infarction (STEMI), evidence suggests that patients with acute coronary syndromes presenting without ST elevation (nSTEACS) also benefit from early angiography and intervention. This management strategy reduces the likelihood of re-infarction, recurrent angina, hospital readmission, and long-term death rates compared with medical therapy alone in this group of patients. This has led international professional bodies, such as the European Society of Cardiology to recommend that PCI should be performed within 48 hours of hospital admission for patients with high-risk nSTEACS.

The London Cardiovascular Project was developed as a case for change to improve cardiovascular services in London. The available evidence suggested that clinical outcomes for the high-risk nSTEACS could be improved and the service for these patients further developed. The London Cardiac Networks were directed by NHS London to support local implementation across the capital with North East London Cardiac and Stroke Network leading on the nSTEACS workstream.

The nSTEACS model describes a pathway across a clinical network that sees the direct transfer of ‘high risk’ nSTEACS patients from A&E to a specialist interventional centre for assessment and, if indicated, coronary intervention. In this model, patients are offered angiography within 24 hours of initial assessment. If a patient is triaged in a hospital that cannot provide angiography within 24 hours, the patient is to be transferred to a unit that can provide this service. This pathway improves access to the interventional centre, avoids an admission at the district general hospital and long waits for inter-hospital transfer.

The initiative involved close collaboration across organisations, including the London Ambulance Service, the local primary care trusts (PCTs) and emergency physicians. The work included defining the patient group and clinical assessment criteria, education and training to DGH accident and emergency departments and modelling capacity implications at the interventional centre. Quality standards have also been developed and agreed with the involvement of London clinicians and patient representatives to ensure the highest possible quality of care is available at each stage of the patients’ journey.

With the avoidance of an inpatient admission, PCTs will no longer be charged for the “actual or suspected myocardial infarction”, and thus save the tariff of £3,662.

Early implementers of the pathway started in September 2011 and since March 2012, all London hospitals “fast-track” high-risk nSTEACS patients. The network has commissioned a joint evaluation of this service with results expected in the next financial year.

4. Using the Myocardial Ischaemia National Audit Project (MINAP) to improve patient care in East Midlands Ambulance Service (EMAS)

Deborah Shaw – Clinical Audit and Research Manager
East Midlands Ambulance Service

MINAP was established to examine the quality of management of heart attacks (myocardial infarctions [MI]) in hospitals in England and Wales. Participation in MINAP has helped to strengthen the partnerships EMAS has with local hospital trusts. This has benefited our cardiac patients as working together with the hospital has helped us to identify areas of care which could be improved.

There is strong evidence to show that mortality rates in MI improve the faster thrombolytic treatment or angioplasty are delivered. EMAS therefore take seriously breaches in the time to treatment targets set in MINAP. To this end, representatives from EMAS attend regular meetings with the local hospital trusts where individual cases identified as being possible breaches in the MI care pathway are discussed. Once discrepancies between ambulance records and the entered data have been identified the remaining cases are examined.

Breaches identified as having occurred whilst the patient was in the care of EMAS are taken back and discussed with the clinicians who attended the patient. Valid reasons for delays are fed back to the group and, where appropriate, amended in the MINAP data. This process also allows us to identify training needs.

issues or problems within the EMAS care processes enabling us to put in place steps to improve our service to patients.

This practice has led to several joint educational initiatives being developed. It was noted that MIs weren’t always being identified from ECGs and therefore a series of ECG recognition workshops for ambulance clinicians were developed by a paramedic who is also one of the Trust’s quality improvement leads. These are co-delivered by a consultant cardiac nurse from one of the local hospital trusts. The workshops emphasise MI recognition, identification of reciprocal changes and the need to keep on-scene times to a minimum to ensure the patient has quick access to appropriate interventions. Information leaflets were also produced which can be given to patients’ relatives. One primary PCI centre contacted the Trust to commend paramedic Claire Hill on her quick thinking and skilled treatment which had certainly saved the patient’s life and led to an extremely good prognosis; Claire commented, “Clinical decision making is a vital element of the paramedic role, I feel that the excellent foundations laid down by Alun Roebuck and Mark Hall during the ECG cardiac workshops, provided me the confidence and knowledge to ‘think out of the box’ whilst making a clinical decision that was ‘the correct one’ and, more importantly, right for the patient. Additionally, being able to provide a primary PCI information leaflet to the patient’s anxious daughter enabled me to leave scene promptly, knowing that the daughter had a point of contact.”

A project aimed at reducing on-scene times for chest pain patients is also in progress in one division of EMAS. Ambulance clinicians attend quality improvement workshops and use process mapping and cause and effect diagrams to identify causes of on-scene delays and solutions for reducing or eliminating those delays. Interventions will be developed, trialled and measured to see whether they do reduce time on scene. A spread process will be used to trial the most effective interventions in other areas of the Trust to see whether the improvements are reproduced. The intention will be to establish the most effective interventions into the care processes across the whole trust.

These are just some of the positive effects on patient care which involvement in MINAP is having in EMAS.

5. Reducing the delay to reperfusion by calling 999 - Primary Care Acute Chest Pain Awareness Project in South West Wales

Alison Turner - MINAP/Call to Reperfusion Improvement Facilitator, South Wales Cardiac Network

Marc Thomas - Information, Communications & Project Manager, South Wales Cardiac Network

The Primary Care Acute Chest Pain Awareness Project addressed the evidence demonstrated by analysis of the MINAP database that people in Wales are more likely than their English counterparts to call their GP than dial 999 directly. In conjunction with the British Heart Foundation, resources were developed to support a systematic approach to raising awareness, in both primary care and the public, of the need to respond to chest pain by dialling 999 rather than calling surgeries by telephone or attending in person.

Questionnaires performed before and after educational sessions in primary care and the provision of printed information, demonstrated that there was an increase in those STEMI patients contacting 999 directly (8.7%) with a corresponding reduction in those being admitted after seeing their GP.

Data for a similar region in England and a neighbouring region in Wales were compared. The greatest improvement was demonstrated where both resources and primary care education had been provided.

Concerns that the project would create a significantly higher workload for the Welsh Ambulance Service were allayed by the analysis of all chest pain calls pre and post project implementation. There was no increase in these calls, leading to the conclusion that the calls would have been made to the 999 system eventually, but were now being made in a more timely way.
The project started when thrombolysis was the first line treatment for STEMI patients in South West Wales. However, this approach to accessing reperfusion is just as applicable to primary PCI where patients are conveyed straight to the tertiary centre. Both treatment options have better outcomes the earlier the intervention; reducing access delays are important.

The resources developed include (Figure 23):

- Posters for public places, depicting signs and symptoms of acute chest pain and what to do
- Concertina leaflets with a similar message, for use in rehabilitation / chronic disease management clinics, or any public event
- A flow chart providing a systematic approach for non-clinical staff to signpost those complaining of acute chest pain to the 999 system (both presenting over the telephone requesting a GP appointment or in person presenting to the GP surgery)
- A flow chart providing a systematic approach for clinical staff, who may not regularly deal with acute chest pain presentations, to enable a systematic approach.

These resources can be downloaded from the South Wales Cardiac Network website along with a generic PowerPoint presentation that can be adapted to suit local use.

For further information please contact either Alison Turner alison.turner@wales.nhs.uk or Marc Thomas marc.thomas@wales.nhs.uk

The South Wales Cardiac Network project team would like to thank the following for their support:

- British Heart Foundation
- Welsh Ambulance Service Trust
- North East England Cardiovascular Network

Figure 23. Posters, leaflets and flowcharts to raise awareness of the need to respond to chest pain by dialling 999
6. Using MINAP data to reduce Call to Needle time in North Wales

Lucy Trent – Independent Nurse Practitioner, Cardiology Wrexham Maelor Hospital

Wrexham Maelor Hospital is one of three general hospitals that form part of Betsi Cadwaladr University Health Board - the largest health trust in Wales. Our area is one of the few places in the UK where medication (thrombolysis) is the commonest treatment for acute heart attack [rather than immediate coronary stenting] and we continue to strive to increase the delivery of thrombolysis in the community, before arrival at hospital - pre-hospital thrombolysis (PHT) - which is around 19% of the total. Because of the rural geography of North Wales, there are significant challenges in meeting the Call-to-Needle (CTN) time standard of 60 minutes, unless the patient receives PHT. Monitoring the level of PHT through MINAP and close working with the Welsh Ambulance Service is crucial for us to provide a high quality service for patients.

Other issues influencing achievement of the CTN time are the level of Paramedic confidence in interpretation of the ECG and the fairly restrictive Joint Royal Colleges Ambulance Liaison Committee protocol for pre-hospital thrombolysis administration.

Various methods have been adopted in an attempt to increase the confidence of Paramedics in North Wales to give PHT. For example, a rolling programme of ECG teaching incorporating Basic, Advanced and Arrhythmia days have been provided on a monthly basis for the past 4 years. These days are delivered by Cardiology Nurse Practitioners at all three sites across North Wales and are aimed at Primary and Secondary care staff and at Ambulance Service personnel. Additionally, Thrombolysis Update days, targeted at Paramedics, incorporate discussion about real cases, advanced ECG recognition and how to access support, advice and feedback about cases they have dealt with.

Monthly Thrombolysis Review meetings take place and involve a Consultant Cardiologist, and staff from the cardiology ward, the emergency department (ED) and the Welsh Ambulance Service, the ED/Cardiology Ward Matron and a Cardiology Nurse Practitioner. MINAP data and particular cases are reviewed and critiqued in order to identify areas for improvement. Examples of good practice are also highlighted and fed back to the relevant staff.

Later this year an exciting development will be the transmission of ECGs via email as pdf files from the ambulance directly to the ED or Coronary Care Unit at the receiving hospital. This has been a difficult project to develop in no small part due to transmission problems within the beautiful but mountainous landscape of North Wales. Following technological advances the quality of the transmitted ECG is now good enough for clinicians in the ED to give advice to the Paramedic on scene. This should enhance the decision making skills of the Paramedic while ensuring that the clinical decision of whether or not to deliver thrombolysis rests firmly with the Ambulance staff on the ground. A telemetered ECG will also enhance the ‘pre-alert’ sent to the receiving unit, even on those occasions when the Paramedic cannot deliver PHT. This can save valuable minutes in providing definitive treatment.

We hope that these initiatives will continue to improve the care for heart attack patients in North Wales.

7. Using MINAP to reduce Call to Needle times in North Wales

Philip M. Jones - Clinical Support Officer, North Region, Welsh Ambulance Service Trust

Time is critical in the management of people with myocardial infarction. Minutes lost at any stage may adversely affect outcomes. Early diagnosis is pivotal and early treatment may be life-saving. If, as in North Wales, primary PCI is not readily available, thrombolysis should be given to patients with STEMI as soon as possible and within 60 minutes of their call for help, by the first appropriately trained person available. In our largely rural community, for many patients this can only be achieved by the delivery of pre-hospital thrombolysis (PHT) – intravenous thrombolytic treatment given before or during transport to hospital by paramedic ambulance personnel. During the past year 86 patients have received PHT.

One of my responsibilities within the Welsh Ambulance Service Trust is to review all cases of PHT. This requires close liaison with colleagues in our receiving hospitals, with our team of paramedics and our audit department.
A ‘call to needle’ time is calculated for every patient who has received PHT. Acquired 12 lead ECG rhythm strips are reviewed and collated on to a database prior to being forwarded to the audit department. Acute Coronary Syndrome forms and Patient Clinical Records relating to these patients are scrutinised for exceptions to the 60-minute target. When the target is not met, a review takes place in an attempt to improve the service.

Meetings are held each month at each of the hospitals, allowing detailed discussions of all relevant cases, focussing on areas for improvement – lessons to learn. Individual paramedics are offered feedback and any necessary support.

I work closely with each of the hospital leads to ensure accurate MINAP data entry, particularly insofar as it reflects the earliest stage of heart attack care. We also support each other through training. It is important that all paramedics are confident in 12 lead ECG interpretations. Paramedics attend a programme of ECG refresher training, organised and delivered by Cardiology Nurse Practitioners from Betsi Cadwalader University Health Board. Each month a North Regional Pre-Hospital Thrombolysis Newsletter is circulated to operational staff.

Within the Ambulance Trust the pre hospital management of STEMI, including PHT, are included as a part of overall clinical performance indicators (CPI). This is a useful tool in the clinical effectiveness toolbox that can be used in the drive to improve the quality of patient care. The STEMI CPI is made up of six individual criteria - all interventions that should, when added to PHT, optimize the chances of restoring coronary blood flow in someone with STEMI. Together they constitute a care bundle, namely:

- Aspirin administration
- Glyceryl Trinitrate (GTN) administration
- Pain assessment
- Morphine administration
- Analgesia (Morphine and/or Entonox) administration
- Oxygen saturation measurement

Existing national guidelines for ambulance personnel management of heart attack exclude some patients from consideration for PHT, e.g. age limit. Such clinical practice guidelines are being reviewed and we will continue to refer to them in our efforts to provide the best of care for the population we serve.

8. Our service

Luke Coleman - Service Improvement Analyst, Greater Manchester and Cheshire Cardiac and Stroke Network

Samantha Chapman - Primary PCI Coordinator, Central Manchester University Hospitals NHS Foundation Trust

Adelaide Berrie - Primary PCI Coordinator, University Hospital of South Manchester NHS Foundation Trust

Roger Gamon - Programme Manager, Greater Manchester and Cheshire Cardiac and Stroke Network

Dr Farzin Fath-Ordoubadi - Consultant Interventional Cardiologist, Central Manchester University Hospitals NHS Foundation Trust

In Greater Manchester and Cheshire, we have two Heart Attack Centres (HACs) that perform primary PCI – Manchester Royal Infirmary and Wythenshawe Hospital. They treat about 1200 heart attacks a year, accepting patients directly from North West Ambulance Service (NWAS) and from twelve Accident and Emergency (A&E) departments across the local District General Hospitals. We serve a population of nearly 3 million people (equivalent to the population of Wales!)

We have the benefit of two primary PCI co-ordinators, one based at each HAC. Although busy members of the cardiology team, they also act as a point of contact for any problems that may occur. They collect data for MINAP and the Cardiac Network; monitor performance; as well as run educational road-shows with local A&E staff.

All primary PCI services are keenly watching their call-to-balloon times and monitoring for bottlenecks in their service which may lead to delays in patients receiving the best care.
MINAP data is essential to inform service improvement work. Broadly speaking we have three potential sources of delay:

- Ambulance availability (with a paramedic crew)
- Assessment and referral at A&E departments
- Access to catheter labs at the HAC

We strive to maintain data that are as current as possible. We collaborated with NWAS to ensure our IT systems integrate. As well as call-to-balloon times we monitor every step of the patient’s journey. In addition, the co-ordinators act on individual cases when necessary. The Network also produces aggregated and individual hospital reports on different aspects of the pathway.

Direct referral by the ambulance service will always prove to be the better option to ensure patients are treated in a timely manner. Whenever a patient is picked up by NWAS but taken to a local A&E rather than the nearest HAC, the primary PCI co-ordinators and NWAS clinical governance team investigate the reasons why. There are many valid reasons for this, but if it was a missed opportunity for immediate transfer to the HAC then the details are fed back to the crew involved and the Advanced Paramedic team to assist with training.

**DIDO?**

A&E departments have played an invaluable role in heart attack management, especially over the last 25 years, and in our view A&E departments will continue to be a crucial element of our heart attack service. However, as the service has matured, more and more patients are being directly referred by the ambulance service to the HACs. As a result, District General Hospital A&E departments are seeing less and less heart attack patients. Many of them no longer have the chest pain specialist nurses available from the thrombolysis era. MINAP data shows that only about half of the patients that are admitted to a local A&E en route to the HAC achieve the call-to-balloon target of 150 minutes. Closer scrutiny of the data at the A&E shows that many patients have long Door-In-Door-Out (DIDO) times, averaging about 60 minutes for straightforward cases.

To help improve this, the primary PCI co-ordinators are running educational road shows – highlighting the details of the pathway and presenting each A&E’s clinical audit results for their DIDO times.

Looking to 2012-13, the Network is also looking at introducing a local quality indicator to measure: the DIDO times for straightforward cases. Harking back to the days when patients were treated with thrombolysis within 30 minutes, we hope patients will be in and out of the A&E within 30 minutes (Figure 24). Another goal is to invite A&E staff to visit catheter labs as part of their training to see the end results of their good work in keeping DIDO times as low as possible.

**Figure 24. Call to balloon times and breakdown of journey steps**
9. Use of MINAP data to develop and evaluate a 24/7 primary PCI service.

Lynne Charlton – Clinical Co-ordinator, Cardiology
The Belfast Trust pPCI Group
Belfast Health & Social Care Trust

The Cardiology Team in the Belfast Health & Social Care Trust (BHSCT) delivers care on three acute hospital sites within the City of Belfast, and in addition provides a regional cardiac catheterisation service for the Northern Ireland population. In 2008, following a review of trial evidence and clinical guidelines, the BHSCT Cardiology team decided to develop a primary PCI pilot service delivered on the Royal Victoria Hospital site on a ’24/7’ basis and accessible to all patients with STEMI within the Belfast Trust City catchment area.

The Belfast Trust has submitted data to MINAP for several years. MINAP data from all three acute sites was instrumental from the outset of the primary PCI pilot implementation plan to estimate the number of potential patients who would access the service, and to determine trends in method, time and site of presentation. Analysis of the data was key to informing discussions and in engagement with our colleagues from the Emergency Departments (ED) and the Northern Ireland Ambulance Service (NIAS), in order that they could assess the potential impact on their services.

In 2008/9 47% of patients in England and Wales received primary PCI as their treatment for STEMI. Our Primary PCI pilot, which commenced in December 2009, was the first in Ireland to offer a primary PCI service on a 24/7 basis and to date there have been 603 activations of this service.

Evaluating the safety and quality of the pilot service is of paramount importance. Robust audit is carried out by collating individual patient level data. The data extracted from MINAP, alongside other data sources, is used to construct timelines relating to each patient’s pathway of care which are crucial in assessing how well the pilot service is performing in relation to national and international standards.

Data is reviewed at the primary PCI steering group where the primary PCI Co-ordinator, nurses, clinicians and managers meet regularly to review performance and quality matters, identify potential ways of improving the patient pathway and highlight excellent practices and outcomes to staff within the Belfast Cardiology team, and also to our ED and NIAS colleagues.

As part of the Programme for Government, the Department of Health, Social Services & Public Safety Northern Ireland plan to further develop a new primary PCI service model in Northern Ireland.
10. Effective data collection for nSTEMI
Fiona Robinson – Cardiac Nurse Practitioner
Mid Essex Hospital Services NHS Trust

When we started collecting data for MINAP we needed a fool-proof method of identifying patients. It quickly became apparent that if we were to rely on colleagues informing us of patients admitted with acute coronary syndrome, we were unlikely to capture all the patients requiring entry into MINAP. Therefore patients admitted to hospital with obvious or dynamic changes on their ECGs would have been identified, but those with more subtle changes may have been missed.

We approached our colleagues in our Biochemistry laboratory and, by liaising directly with them, we arranged that we would get a daily print out of all the patients who had had a Troponin blood analysis performed.

We have adapted the MINAP data collection form, dividing it into two parts. The data for Part 1 [Figure 25] is collected by the Acute Cardiology Nurses who see the patients shortly after admission to the hospital. The patients’ demographic data is obtained from the Patient Administration System, along with dates of admission, names of admitting consultants, and General Practice details. Patients are then located within the hospital and visited on an individual basis and reviewed. Audit data is collected from the patient’s notes. It also gives us an opportunity to review the patient’s history, symptoms, risk factors and ECG and ensure an appropriate management plan is in place for the patient. This therefore combines the process of data collection with enhanced clinical care. The majority of the patients we follow up are situated on our Acute Admissions Wards and therefore have been reviewed by the Cardiology team who perform a daily ward round. However there are a few who have been admitted to outlying wards and are picked up as a result of the elevated blood Troponin level. A typical example of such a case would be an elderly patient, possibly admitted with a fracture to an Orthopaedic ward, who may have had a Troponin estimation on admission blood testing to investigate the cause of his/her fall. We would then ask the Orthopaedic team to consider getting a formal Cardiology review and to consider transfer of the patient to a more appropriate area. By identifying these patients they can

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**Figure 25. Part 1 collected by Acute Cardiology Nurses**

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NB: All fields marked with *should* be completed to achieve 100% Data Completeness.
Figure 26. Part 2 collected by Cardiac Rehabilitation Team

NB: All fields marked with should be completed to achieve 100% on Data Completeness.

be offered further investigations and also have the opportunity to be seen by the Cardiac Rehab team prior to discharge.

When Part 1 is complete the data is passed over to the Cardiac Rehabilitation team who will collect the remaining information (Figure 26) with regards to discharge medication, rehab advice, any referrals for investigation/interventions etc. Once complete this form is passed to our Information Services department who enter the data for us.

11. St George’s Hospital’s pPCI Service
Dr Maciej Marciniak – Specialist Registrar
Dr Pitt O Lim - Consultant Cardiologist
Department of Cardiology, St George’s Hospital, London

The major determinant of good outcome in MI is early coronary revascularisation. Hence the challenge is increasing public awareness for symptoms and signs of MI so that those who are having an MI will “call for help” as soon as possible. The ambulance service then takes the patients to designated Heart Attack Centres [HAC] for emergency primary percutaneous coronary intervention [pPCI]. The occluded coronary artery is unblocked with a balloon and the culprit segment of the coronary artery is stented. This “call to balloon” time therefore describes the patient journey from home to the cardiac catheter laboratory. It is a marker of the robustness of ambulance service and hospital set up, this duration closely and inversely correlates with survival and outcome of MI. The Danish researchers demonstrated that each hour delay is associated with a 10% reduction in survival [Terkelson and colleagues JAMA 2010; 304: 763].

The pPCI service at St George’s Hospital [SGH] has been in place since October 2005 covering the population in the south west of London with the help of the London Ambulance Service [LAS], and the service was extended to Surrey from May 2006 with the help of the South East Coast Ambulance Service [SECAMB]. As it takes longer for patients to journey from Surrey to St George’s Hospital, we have installed the LIFENET system whereby an ECG can be wirelessly transmitted to our Coronary Care Unit [CCU] for confirmation of MI prior to the journey which can take up to 45 minutes.
Our pPCI service can be illustrated by the case, a 68 year old man who experienced pain across his chest at 11:45. He fortunately called for help early at 12:13, and was attended to by the SECAMB within five minutes, see the ECG transmitted to the CCU (Figure 27).

He was taken to St George’s Hospital, bypassing his local hospital (8 miles), arriving at the door of the HAC at 13:15 (15 miles), and was taken to the CCU first as the pPCI team was not on site over the weekend, and then to the cardiac catheter laboratory when the pPCI team was fully assembled. The call for help to door time was therefore 62 minutes.

He underwent right radial approach emergency coronary angiography and was found to have occluded his right coronary artery. The artery re-opened with wiring, without the need for thrombectomy, and it was directly stented at 13:52 (Figure 28, upper panel). Hence the door to balloon time was 35 minutes (well below the golden hour) and the call to balloon time was 97 minutes (< 150 minutes).

He was also found to have a sub-totally occluded left anterior descending artery, the distal vessel was collateralised by collaterals from the re-opened right coronary artery. As there was high likelihood that he would be symptomatic from this lesion, the artery was wired and directly stented (Figure 28, lower panel). Subsequent echocardiogram revealed preserved cardiac function with mild hypokinesia in the right coronary artery territory and apical akinesia suggestive of previous distal left anterior descending artery MI. His recovery was uneventful. He was discharged 3 days later and was followed up at his local hospital.

It has now been one year since the patient’s MI, he has completed his cardiac rehabilitation program locally and he is completely asymptomatic. This case illustrates that it is possible to deliver a world class primary PCI service when different service components work in concert to achieve a common goal.
12. Shifting the Focus
Nicola Manning – Cardiology Audit Nurse
Emma Gendall - Cardiology Audit Nurse
North Bristol NHS Trust (NBT)

During the past 10 years we have been committed to MINAP data collection at North Bristol NHS Trust (NBT), working hard to ensure our data is accurate and robust. We regularly review our data locally and discuss it with our clinicians.

In 2009, NBT ceased to operate a primary PCI (pPCI) service following a strategic decision to transfer STEMI patients to the nearby Heart Institute. This provided us with a unique opportunity to shift our focus toward nSTEMI patient care. We seized this opportunity and after securing additional staff, commenced data collection on all nSTEMI patients. This additional data enabled us to perform in-depth analysis of our nSTEMI pathway in order to identify potential areas for improvement.

The Avon, Gloucester, Wiltshire and Somerset (AGWS) Cardiac & Stroke Network and local clinicians were also keen to look at nSTEMI care on a regional level. As a result, five standards, directly relating to NICE guidance (CG94) for Acute Coronary Syndrome (ACS), were devised. In formulating these standards it was important to ensure they correlated with the MINAP dataset enabling easy data extraction and analysis. The 5 standards are as follows:

- Percentage of patients cared for in CCU
- Percentage of patients reviewed by a cardiologist within 24 hours
- Percentage of patients reviewed by a cardiologist during admission
- Percentage of patients receiving Glycoprotein IIb/IIIa inhibitors
- Percentage of patients receiving angiography within 72 & 96 hours of admission

All hospitals within the AGWS Network agreed to provide this data from MINAP and this is currently reviewed at quarterly meetings. This is an example of national audit being used to improve regional services. At NBT this enables us to directly compare ourselves in specific areas of nSTEMI care against other local hospitals. Where we identify variation in performance this is discussed with other hospital teams to determine how performance can be improved. This collaborative working has enabled us to progress nSTEMI patient care and service provision network-wide.

An example of this is the role of outreach ACS nurse specialists, which appeared to be a key element of those hospitals performing well. At NBT we were able to take this evidence, derived from MINAP, to aid development of a cardiology outreach nurse position. We have now appointed and a 6 month trial is due to commence shortly. With this nurse in post we are confident that an improvement in our admission to angiography timings and length of stay will be evident. The MINAP database will be instrumental in continually tracking this progress, enabling our service to evolve.
1. Overview

Prof Adam Timmis – Chairman of MINAP Academic Group & Professor of Clinical Cardiology, Barts and the London School of Medicine and Dentistry
Lucia Gavalova – MINAP Project Manager

MINAP now has over 1 million records with almost 100% hospital participation since 2003, making it the largest collection of ACS data in the world covering most of the patient population in England and Wales. As such it is an invaluable research resource for observational studies.

The MINAP Academic Group was delegated responsibility by the Health Quality Improvement Partnership (HQIP) to release its audit data to external researchers. Research applications are considered by the MINAP Academic Group, and if approval is given the data fields required for the research are made available. Some preference is given to those researchers with a track record and experience in working with large and complex datasets. More recently, the NICOR Research Group has been set up to oversee research strategy across all the datasets under its custodianship.

When NICOR was established in 2011, it facilitated the linkage of the national cardiovascular audits providing researchers with a unique resource for tracking patients through their cardiovascular journey. MINAP has also been linked with CPRD (Clinical Practice Research Database) to explore patient care before and after a heart attack.

Vital status is updated annually by the Office of National Statistics. Researchers only have access to anonymised data. This is in compliance with the strict governance rules that ensure patient confidentiality.

The MINAP Academic Group welcomes applications from MINAP hospitals that are interested in regional or national analyses that seek answers to valid research questions, and are able to facilitate collaborations with experienced academics and statisticians.

To date, over 35 publications have resulted from the use of MINAP data and more projects are currently on-going following an approval by the MINAP Academic Group. The following sections highlight just a few that were published in the last year or so.


Dr Alex Simms - Cardiology Specialist Registrar
Dr Chris Gale - Consultant Cardiologist
Centre for Epidemiology and Biostatistics, University of Leeds

MINAP reports hospital performance – the care provided at each hospital to patients admitted there – in terms of a number of different indicators of good quality care. Each of these indicators identifies one intervention, among many, that has been shown to improve the outcome for patients experiencing heart attack. We used data from MINAP to design and study a summary or composite score of how hospitals provided a number of these previously described single measures. We advocate summary scores rather than single indicators of care (such as “did all patients receive aspirin on discharge”) because they measure achievements across a wider range of care. Our indicator was an opportunity-based composite score (OBCS) designed to be incorporate data from patients discharged from hospital following a heart attack.

The score measured all the fulfilled opportunities a hospital had to provide a care process, expressed as a percent. The care processes we used were the prescription of aspirin, thienopyridine inhibitors, β-blocker, ACE inhibitor and statin, as well as referral for cardiac rehabilitation.

We found that, overall, 95% of opportunities to provide care were achieved. This varied between hospitals in England and Wales – ranging from 76% to 100% across 199 acute hospitals. A funnel plot of hospital OBCS allowed visualisation of this variation between hospital (Figure 29). We also found that the OBCS more readily highlighted hospitals (24%) that needed to improve their performance, than using the individual components of the OBCS, and that it showed greater consistency in identifying lower performing hospitals.

Importantly, our study demonstrated that the OBCS had a significant inverse relationship with death at 30-days and at 6-months. It showed that better performing hospitals had lower mortality rates. This effect persisted despite adjustment for differences in patient characteristics and the performance of coronary artery catheterisation. Each percentage increase in hospital OBCS was associated with, on average, a 3% and 2% decline in 30-day and 6-month death rate, respectively.

In conclusion, our study found that the OBCS offered a summary of hospital care for patients with heart attack, discriminated hospital performance and was linked with longer-term outcomes. The OBCS may therefore be suitable for inclusion in hospital quality-improvement strategies and for the comparison of hospital performance in England and Wales.
3. International comparisons

Prof Adam Timmis – Chairman of MINAP Academic Group & Professor of Clinical Cardiology, Barts and the London School of Medicine and Dentistry

An exciting development in MINAP based research has been an international collaboration with Swedish Investigators. Sweden is the only other country in the world which, like England and Wales, has a national registry (SWEDEHEART) recording all admissions of patients with acute coronary syndromes. This provides a unique opportunity to compare patient outcomes and develop insights into differences that might exist between the process and quality of care in the two countries. The UK team is headed by Harry Hemingway with Sheng-Chia Chung at UCL - plus representatives from NICOR - while the Swedish team comprises a renowned group that includes Stefan James, Anders Jeppsson, and Tomas Jernberg. The project required careful alignment of the MINAP and SWEDEHEART registries in order that the respective data-fields were comparable before proceeding to a 30-day survival analysis. The data will be presented later this year at the American Heart Association meeting and already a draft paper has been prepared for publication in late 2012 or early 2013. Special attention will be given to comparing emergency management and how it affects survival. So successful has been the MINAP-SWEDEHEART collaboration that plans are now being made for further comparative studies to learn more about differences in the management and prognosis of patients with myocardial infarction in England and Wales and Sweden. The expectation is that in future years collaborative research of this sort will extend to other countries in order to maximise MINAP’s research potential and learn more about effective ways to further reduce coronary mortality in England and Wales.

4. Prognosis following cardiac arrest complicating ST-elevation myocardial infarction

Iain Squire – University of Leicester, Department of Cardiovascular Sciences and NIHR Biomedical Research Unit in Cardiovascular Disease

Albert E Alahmar - University Hospitals of Leicester, Department of Cardiology

Kym Snell – University of Leicester, Department of Cardiovascular Sciences and NIHR Biomedical Research Unit in Cardiovascular Disease

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Adam Timmis - Barts and the London School of Medicine and Dentistry

John Birkhead – Former MINAP Clinical Director, National Institute for Cardiovascular Outcomes and Research

Nilesh J Samani - University of Leicester, Department of Cardiovascular Sciences and NIHR Biomedical Research Unit in Cardiovascular Disease

Cardiac arrest is a dramatic complication of acute myocardial infarction (AMI), one which often has important psychological consequences for the patients, their family, and healthcare professionals. Instinctively one might think that cardiac arrest would be associated with poor outcome after AMI. However the relevance of cardiac arrest complicating AMI to future
prognosis is, surprisingly, unclear. The MINAP database allows consideration of this issue. We assessed the relevance to survival of cardiac arrest. We were particularly interested in the impact of cardiac arrest on survival in patients who were later discharged alive from hospital. Similarly, we considered whether cardiac arrest influenced outcome after 30 days if the patient lived to that point, and whether it influenced outcome after 1 year if the patient was alive at that time.

We analysed data from 41,467 patients admitted with ST-segment elevation AMI between 2008 and 2010. Cardiac arrest was surprisingly common, recorded for 4,240 individuals, 10.2% of the population. Approximately 30% of patients experiencing cardiac arrest died before discharge.

Without adjustment for other clinical factors, cardiac arrest was associated with increased risk of 30-day mortality, as were greater age, higher heart rate and lower blood pressure on admission to hospital. However, after adjustment for covariates, cardiac arrest had association with mortality up to, but not after, 30-days. In other words, the occurrence of cardiac arrest during the early stages of AMI is associated with increased risk of death only up to 30 days after the event. Our results suggest that, for patients surviving to discharge from hospital after AMI, cardiac arrest is associated with increased risk of death by 30-days, but not thereafter. Patients experiencing cardiac arrest after AMI may merit intensive monitoring for one month, but can be reassured that this dramatic event has no apparent association with mortality risk after that point.

5. The effects of hourly differences in air pollution on the risk of myocardial infarction: case crossover analysis of the MINAP

Dr Krishnan Bhaskaran – Lecturer in Statistical Epidemiology, London School of Hygiene and Tropical Medicine

Prof Paul Wilkinson – Professor in Environmental Epidemiology, London School of Hygiene and Tropical Medicine

A unique strength of MINAP for research is the availability of timing data on acute coronary syndromes. As part of a study investigating the associations between environmental exposures and myocardial infarction (MI) risk, we linked 79288 MI events in MINAP by time and location to data on ambient pollution levels obtained from pollution monitoring stations in 15 large conurbations in England and Wales during the period 2003-2006. We assigned times to individual MIs using the recorded time of symptom onset, where it was available (74% of cases), for the remainder we used time of call for help, or time of arrival at hospital. For each individual experiencing an MI, we compared their exposure to five key pollutants at the time of their MI, with their exposure at the same time of day on other days in the same calendar month (when they did not have an MI). We also looked for associations between pollution levels and MI risk that might be delayed (lagged) by up to 72 hours, since exposure to pollution at a particular time might affect MI risk some time later.

Higher ambient levels of small particles (known as PM10), and nitrogen dioxide (NO2), which are typically traffic-related, appeared to be associated with transiently increased risk of myocardial infarction 1-6 hours after exposure (Figure 30. For every 10μg/m3 increase in PM10 and NO2 levels, MI risk was estimated to increase by 1.2% and 1.1% respectively. Interestingly, we observed that later reductions in risk appeared to offset the initial risk increase; over a 3-day period, higher pollution levels were not associated with a net increase in MI risk. This suggests that exposure to traffic-related air pollution may be associated with triggering MIs early in highly vulnerable patients who would in any case have experienced an MI a little later. For ozone, carbon monoxide (CO) and sulphur dioxide (SO2) there was no evidence of any detrimental effect.

Our study was the largest to date to investigate associations between the commonly measured pollutants and myocardial infarction risk at an hourly temporal resolution. MINAP’s coverage means that hospital admissions recorded should have been representative of those occurring within the conurbations under study, though one must be mindful of the fact that MIs leading to death before hospital admission would have been excluded from our analysis. A further strength was that we were able to use information within MINAP to validate MI diagnoses: 89% of diagnoses were backed up by electrocardiogram (ECG) or blood marker data (troponin/creatinine kinase) consistent with MI.

Our results suggest that there may be limited potential for reducing the net burden of MI through reductions in pollution alone, but that should not undermine calls for action on air pollution, which has well established associations with broader health outcomes including overall, respiratory, and cardiovascular mortality. One implication of our findings is that other, perhaps non-thrombotic, mechanisms are more important drivers of this net mortality increases associated with higher pollution levels.

Figure 30. Estimated excess risk of myocardial infarction over time associated with exposure to different pollutants.
1. Importance of nSTEMI data collection

Some years ago the Myocardial Infarction National Audit Project became the Myocardial Ischaemia National Audit Project. This subtle change of title was intended to emphasise that participation in MINAP provided an opportunity to analyse the care of all patients admitted to hospital with ACS, and not just those with ST-elevation. Patients presenting with, rather than without, ST-elevation are more easy to identify and their immediate management lends itself to audit – through reporting reperfusion rates and delays to reperfusion (e.g. Door-to-balloon). However most patients with ACS have nSTEMI.

Compared with STEMI, patients with nSTEMI tend to be older and have more associated medical (and presumably social) problems. While most patients with STEMI are taken directly to Heart Attack Centres for primary PCI, those with nSTEMI – who do not require immediate PCI – tend to be taken directly to the nearest non-interventional hospital, and in some cases later transferred to Heart Attack Centres. Their length of stay in hospital is longer and their risk of dying is greater – albeit those at greatest risk can be identified using validated risk scoring systems.

The identification of nSTEMI (and therefore the collection of data about these patients) is not always easy – see the case study by Fiona Robinson to understand the amount of effort and time that may need to be invested. Nevertheless, as that case study shows, it is not an impossible task, and should, we believe, be the aspiration of all admitting hospitals that are interested in assuring and improving the quality of care provided to this group. Although there has been an improvement in nSTEMI data collection, there are still a number of hospitals that are submitting limited, and in some cases no, data.

MINAP is committed to provide its participating hospitals all possible support, in term of understanding the database, the dataset and its definitions and the available analyses that will inform the hospital about their performance. We will facilitate peer support, where possible, and networking to foster the sharing of good practice for hospitals to learn from each other’s successes.

2. Rapidity of transfer for angiography following nSTEMI

The need for comparative audit is particularly pressing for patients with nSTEMI given the significant variation in the interval from admission to performance of coronary angiography presented in this report. The optimum timing of angiography (and subsequent revascularisation) remains unclear. Groups developing guidelines have interpreted differently the results of trials comparing medical treatment (drugs) and PCI with medical treatment alone, suggesting maximum acceptable delays of anything from 24 to 96 hours. Large numbers of patients are not yet receiving this standard of care. Even if there is no direct relationship between earlier angiography and outcome (judged by mortality and further heart attack), those who do receive earlier angiography are more likely to be discharged home and avoid prolonged hospitalisation.

3. Continued investment in time, personnel and money in participation in national clinical audit

Some perceive national clinical audit as a burden upon already busy NHS staff, the collection and submission of data being divorced from caring for patients. During times of financial constraint there is a temptation to reduce investment in such exercises, even though participation in clinical audit is mandated by the Department of Health. Conversely, we would argue that such conditions – a working environment characterised by cost containment and efficiency – increase, rather than decrease the need for reliable contemporary knowledge of hospital performance. As demonstrated in the case studies, such information, when used wisely, can be used to inform local improvements. Further, it can be used to reassure users, providers and commissioners that the quality of care provided to individual patients is not being sacrificed as services are reconfigured.

The quality of contemporary data is extremely important if a true picture is to emerge. MINAP data are quite complex and its collection, often needing extraction from medical notes, requires experience – it becomes more manageable over time. We strongly recommend that each hospital/Trust has a designated individual responsible for clinical audit data and that they are supported by a local cardiologist as clinical input has shown to result in higher quality data. High turnover and reduction in the number of staff in clinical audit departments is in no one’s interest.
Part 6: Appendices

Appendix 1: MINAP Steering Group

Dr Clive Weston
Chairman
Clinical Director MINAP

Dr Mark de Belder
Interventional Cardiologist,
James Cook University Hospital

Prof Sir Roger Boyle CBE
Co-director of NICOR

Dr David Cunningham
Senior Strategist for National Cardiac Audits, NICOR

Dr Kevin Stewart
Clinical Director, Clinical Effectiveness & Evaluation Unit,
Royal College of Physicians

Prof Peter Weissberg
Medical Director, British Heart Foundation

Prof Tom Quinn
Associate Dean for Health & Medical Strategy, University of Surrey

Ms Fiona Dudley
Lead Nurse for Cardiology:
Mid Yorkshire Hospitals NHS Trust

Prof Adam Timmis
Chairman of MINAP Academic Group

Dr Mark Dancy
National Clinical Chair for NHS Improvement

Sue Manuel
MINAP Senior Developer, NICOR

Mrs Lynne Walker
NICOR Programme Manager

Mr Alan Keys
MINAP Patient/Carer Group Representative

Mr Iain Thomas
MINAP Patient/Carer Group Representative

Dr Iain Simpson
President, British Cardiovascular Society

Ms Lucia Gavalova
MINAP Project Manager

Mr Ronald van Leeven
MINAP Project Co-ordinator

Appendix 2: MAG membership

Prof Adam Timmis
Chair, Professor of Clinical Cardiology, Barts and the London School of Medicine and Dentistry

Dr Mark de Belder
Interventional Cardiologist,
James Cook University Hospital

Dr Clive Weston
Clinical Director, MINAP

Prof Sir Roger Boyle CBE
Co-director of NICOR

Dr David Cunningham
Senior Strategist for National Cardiac Audits, NICOR

Prof Keith Fox
Professor of Cardiology,
University of Edinburgh

Dr Chris Gale
NIHR Clinician Scientist Award
Senior Lecturer in Cardiovascular Health Research and Honorary Consultant Cardiologist

Prof Harry Hemingway
Professor of Clinical Epidemiology, Department of Epidemiology and Public Health, University College of London

Dr Owen Nicholas
Senior Research Associate,
Department of Epidemiology and Public Health, University College London

Prof Iain Squire
Professor of Cardiovascular Medicine, Department of Cardiovascular Science,
University of Leicester

Prof Paul Wilkinson
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Dr Spiros Denaxas
CALIBER Data Manager,
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Lynne Walker
NICOR Programme Manager

Ms Lucia Gavalova
MINAP Project Manager

Dr Emmanuel Lazaridis
Senior Information Analyst, NICOR
Appendix 3: Glossary

ACE inhibitors
A class of drug with powerful vasodilating effects on arteries. Used – in the context of heart attack - for the treatment and prevention of heart failure. Also used widely for treatment of high blood pressure. Angiotensin receptor blockers (ARBs) have broadly similar effects.

Acute coronary syndrome (ACS)
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.

Angiogram
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). Narrowings and complete blockages within the arteries can be identified during the angiogram and this allows decisions to be made regarding treatment. Often an angiogram is an immediate precursor to an angioplasty and stent implantation or to coronary artery bypass grafting.

Anti-platelet drugs
Drugs including aspirin, clopidogrel, prasugrel and ticagrelor that prevent blood clotting. Anti-platelet drugs act by reducing the ‘stickiness’ of the small blood cells that can clump together to form a clot.

Apical
At the apex or tip of the heart.

Arrhythmia
A group of conditions in which there is abnormal electrical activity in the heart. The heartbeat may be too fast or too slow, and may be regular or irregular.

Aspirin
An anti-platelet drug used to help prevent blood clots forming.

Beta blockers
Beta blockers are drugs that block the actions of the hormone adrenaline that makes the heart beat faster and more vigorously. They are used to help prevent attacks of angina, to lower blood pressure, to help control abnormal heart rhythms and to reduce the risk of further heart attack in people who have already had one. They may also be used in the treatment of heart failure.

Call-to-balloon (CTB) time
The interval between the patient alerting the health services that they have symptoms of a heart attack and the performance of primary angioplasty.

Call-to-needle (CTN) time
The interval between the patient alerting the health services that they have symptoms of a heart attack and the administration of thrombolytic therapy.

Cardiac arrest
When the heart stops pumping blood around the body. The most common cause of a cardiac arrest is a life threatening abnormal heart rhythm.

Cardiac enzymes
Cardiac enzyme tests (including troponin tests) help to show if heart muscle has been damaged.

Cardiac rupture
A laceration or tearing of the walls of the heart most commonly seen as a serious complication of a heart attack.

Cardiogenic shock
An inadequate circulation of blood caused by the failure of the heart to pump effectively. It can be due to damage to the heart muscle, most often from a large myocardial infarction.

Cardiomyopathy
A disease of the heart muscle that leads to generalised deterioration of the muscle and its pumping ability.

Cholesterol
A fatty substance mainly made by the liver. It plays a vital role in the functioning of every cell wall throughout the body. The body also uses cholesterol to make other vital chemicals. However, too much cholesterol in the blood increases the risk of coronary heart disease and heart attacks.

Clopidogrel
An anti-platelet drug that has been shown to have added benefit when given with aspirin during an acute coronary syndrome.

Clot dissolving drugs
Drugs used to dissolve the thrombus within a heart artery which is the underlying cause of heart attack, see ‘thrombolytic treatment’.
Coronary thrombosis
The formation of a blood clot one of the arteries carrying blood to the heart muscle.

Contractile function
The ability of the heart to pump blood.

Contractile dysfunction/Hypoccontractility
A decline in pumping action of the heart where contraction is inefficient and unable to adequately supply oxygen and nutrients to body organs.

Door-to-balloon (DTB) time
The interval between the ambulance arriving at a hospital and the performance of primary angioplasty.

Door-to-needle (DTN) time
The interval between the ambulance arriving at a hospital and the administration of thrombolytic therapy.

Electrocardiogram
Also known as ‘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.

Echocardiography
A test that uses sound waves to create moving pictures of the heart. The pictures show the size and shape of the heart, pumping capacity and the location and extent of any tissue damage.

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, and heart failure in people who survive.

Heart Attack Centre
A hospital that provides coronary interventions for patients with acute coronary syndromes.

Heart failure
Heart failure occurs when a damaged heart becomes less efficient at pumping blood round the body. This may result from damage to the heart muscle caused by a heart attack. There are typically symptoms of breathlessness with exertion and, later, swelling (oedema) of lower limbs.

IQR
Interquartile range; the value at 25% and 75% of an ordered set of values.

Left ventricle
The left lower chamber of the heart that receives oxygenated blood from the left atrium and pumps it out under high pressure through the aorta to the body.

Median
The number falling in the middle of a ranked series of numbers.

Myocardial infarction
A heart attack in which heart muscle damage is confirmed by blood testing.

Necrosis
A form of cell injury that results in the death of cells in living tissue.

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.

Pericarditis
Inflammation of the outer sac that surrounds the heart. When pericarditis occurs, the amount of fluid between the two layers of the pericardium increases. This increased fluid presses on the heart and restricts its pumping action.

Pre-hospital thrombolysis
Thrombolytic treatment given before arrival in hospital, usually in the ambulance by paramedics. This saves time in providing treatment and is used with longer journey times.

Primary percutaneous coronary intervention (PCI)
A technique to re-open the blocked coronary artery responsible for the heart attack. A fine catheter (tube) is passed, under local anaesthetic, from an artery in the leg or arm into the blocked heart artery. A small inflatable balloon is then passed through the catheter and across the blockage, allowing the artery to be re-opened by temporary inflation of the balloon. This part of the technique is called angioplasty and when used as the initial treatment for heart attack can be referred to as ‘primary angioplasty’. Following opening of the artery, this is normally kept open by a small expandable metal tube (stent) which is passed into the artery with the angioplasty balloon. The umbrella term that encompasses both balloon dilatation (angioplasty) and stent insertion (stenting) is ‘percutaneous coronary intervention’ (PCI).
Pulmonary oedema
An abnormal buildup of fluid in the air sacs of the lungs, which leads to shortness of breath.

QT interval
A measure of the time between the start of the Q wave and the end of the T wave in the heart’s electrical cycle.

Re-infarction
The development of evidence of re-occlusion (further blockage) of, or development of blood clot within, the coronary artery that was responsible for the original heart attack. This would normally occur after the original blockage had been successfully treated.

Reperfusion treatment
The term used to cover both techniques, thrombolytic treatment and primary PCI, for reopening a coronary artery as an emergency. These treatments are suitable only for certain types of heart attack characterised by typical electrocardiographic appearances described as ST segment elevation.

Revascularisation
Interventions that improve the blood supply to the heart, including PCI or coronary artery bypass grafting

Secondary prevention treatment
Medication that reduces the risk of further heart attack, or the risk of complications such as heart failure. See aspirin, beta blockers, ACE inhibitors and ARBs, clopidogrel and statins. These medications are usually initially prescribed to all patients who can tolerate them.

Statins
Drugs used to reduce cholesterol levels in the blood.

ST elevation myocardial infarction
A heart attack characterized by a specific abnormal appearance on the ECG (ST segment elevation) thought to be indicative of complete occlusion of a coronary artery.

Thienopyridine inhibitors
Antiplatelet agents, of which clopidogrel and prasugrel are presently licensed for use. A similar drug, ticagrelor, is also now being used in some patients.

Thromboembolic complications
Formation of a clot (thrombus) in a blood vessel that breaks loose and is carried by the blood stream to plug another vessel. The clot may plug a vessel in the lungs, brain, gastrointestinal tract, kidneys, or leg.

Thrombolytic treatment
The outcome for certain types of heart attack can be improved by using clot-dissolving (thrombolytic) drugs. Thrombolytic treatment is effective up to about 12 hours after the onset of symptoms but is most effective when given very early after the symptoms started. Thrombolytic drugs are not given unless there are typical changes on the electrocardiogram (ECG). As these drugs are designed to dissolve clots, they may be unsuitable for some patients who are at risk of internal bleeding. Patients at significant risk of bleeding may not be given this treatment where the risk of bleeding is greater than any potential benefit. Where this risk exists primary PCI may be an effective alternative.

Thrombus
A blood clot, the development of which is known a thrombosis.

Ventriculography
A medical imaging test used to determine a patient’s cardiac function which involves an injection of a dye that shows up on X-rays, into the heart’s ventricles to measure the volume of blood pumped.

Appendix 4: MINAP Publications

1999
Rickards A, Cunningham D. From quantity to quality: the central cardiac audit database project. Heart 1999;82: 1118-1122


2000
Birkhead JS. Responding to the requirements of the National Service Framework for coronary heart disease: a core dataset for myocardial infarction. Heart 2000; 84: 116-7

2001


2002

2004
Birkhead, J., Walker, L. MINAP, a project in evolution. Hospital medicine 2004; 452-53.


2005

2006


2007


2008


2009


2010


2011
Cattle BA, Baxter PD, Greenwood DC, Gale CP, West RM. Multiple imputation for completion of a national clinical audit dataset. Statistics in Medicine 2011; 30(22):2736-53


White, C. UK access to primary angioplasty services is still highly variable. BMJ 2011; 343:d10.1136/bmj.d5508 (Published 2 September 2011)


2012


Appendix 5: Contacts for information on heart and heart related conditions

American Heart Association
http://www.heart.org/HEARTORG/Conditions/Conditions_UCM_001087_SubHomePage.jsp

Patient.co.uk
http://www.patient.co.uk/doctor/epidemiology-of-coronary-heart-disease

Blood Pressure Association
http://www.bloodpressureuk.org/Home

British Cardiac Patients Association
http://www.bcpa.co.uk/

British Cardiovascular Society
http://www.bcs.com/pages/default.asp

British Heart Foundation
http://www.bhf.org.uk/

NB: The British Heart Foundation runs a heart information line that provides information about heart conditions and their management. It cannot respond to questions about services in individual hospitals. Tel: 0300 330 3311 (similar cost to 01 or 02 numbers). Lines are usually open 9am-5pm Monday to Friday.

Diabetes UK
http://www.diabetes.org.uk/

National Obesity Forum
http://www.nationalobesityforum.org.uk/

Department of Health website

HEART UK
http://www.heartuk.org.uk/
Heart UK advice helpline 08454 505988

NHS Evidence – cardiovascular
http://www.evidence.nhs.uk/search?q=Cardiovascular+Diseases

NHS Choices
http://www.nhs.uk/Pages/HomePage.aspx

NHS Direct
Tel: 0845 46 47

Healthwatch
http://www.healthwatch.co.uk/
Heart attacks recorded in MINAP in 2011/12